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ANNUAL MEETING ABSTRACTS

# 2023 ACMT Annual Scientific Meeting Abstracts – San Diego, CA



## Day 1: Platforms, Abstracts 001-004

### 001. Postpartum Maternal Opioid Therapy and the Risk of Adverse Neonatal Outcomes

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**Background:** It is widely taught that maternal use of opioids while breastfeeding, and use of codeine in particular, can predispose neonates to opioid toxicity.
**Research Question:** Is postpartum maternal opioid therapy associated with adverse neonatal outcomes?
**Methods:** Population-based retrospective cohort study using propensity score matching in Ontario, Canada, from September 1, 2012 to March 31, 2020. We identified all mother-infant pairs discharged from hospital alive within seven days of delivery. From this group we identified women who filled an opioid prescription within seven days of discharge. We matched each to one woman who did not, matching on age, calendar year, mode of delivery, and logit of the propensity score. The primary outcome was neonatal readmission to hospital for any reason within 30 days of the maternal opioid prescription. Secondary outcomes included any emergency department visit, hospitalization for any injury, admission to an intensive care unit, hospitalization with resuscitation or assisted ventilation, and neonatal death.
**Results:** We studied 85,675 women who filled an opioid prescription within seven days of hospital discharge after delivery and 85,675 women who did not. The median age was 32 years, 60.3% were primigravid, and 80.8% underwent cesarean delivery. In the primary analysis, 2,962 (3.46%) children born to mothers who filled an opioid prescription were hospitalized, compared to 3,038 (3.55%) children born to mothers who did not receive an opioid. Children of mothers who filled an opioid prescription were no more likely to be hospitalized for any reason compared to children born to mothers who did not (hazard ratio 0.98; 95% CI 0.93 to 1.03). We found no differences in any other adverse neonatal outcome, and similar results in a sensitivity analysis involving 17,037 women prescribed codeine.
**Conclusions:** Maternal receipt of an opioid prescription following delivery is not associated with several measures of neonatal harm.

### 002. Exposure to the Endocrine-Disrupting Metal Lead and Serum Estrogen Levels in Women

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**Background:** Multiple factors affect estrogen levels in the body; however, the impact of exposure to environmental chemicals, such as heavy metals, on estrogen levels in humans remains inconclusive. Hypothesis: Is there a relationship between exposure to endocrine-disrupting metal lead and serum estrogen levels in adult women?
**Methods:** This cross-sectional study assesses the association between blood lead levels (BLLs) and serum estradiol in women (aged $\geq$ 20 years) who participated in the National Health and Nutrition Examination Survey between 2013-2016. Due to the impact of pregnancy and female hormone use on estrogen levels, we excluded participants who were pregnant or who used female hormones, resulting in a final sample of 1618 for the analysis. Using multiple general linear models, we estimated the changes (regression coefficient β) of serum estradiol levels (pg/mL) in association with BLLs (μg/dL), adjusting for potential confounders. Age-specific analysis was further conducted.
**Results:** The median of BLLs was 0.76 μg/dL (range: 0.11-12.80) and the median level of serum estradiol was 31.10 pg/

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mL (range: 2.12-523.00) among women aged 20-80 years. A statistically significant inverse association was found between blood lead and estrogen levels (β = -0.121; $p$ = 0.0301), after adjusting for age, race/ethnicity, poverty status, education level, BMI, physical activity, cigarette smoking, alcohol consumption, and use of birth control pills. When stratified by age, a statistically significant inverse association was only seen among women aged 50-80 years ($n$ = 600) (β= -0.363; $p < 0.0001$).

**Conclusion:** Our study demonstrated that increases in lead exposure were associated with decreased estrogen levels in older women, which might be implicated in the earlier menopause associated with increased levels of lead exposure that was observed in previous studies. Further studies are warranted to address limitations, including the cross-sectional nature of the study, and to characterize the interaction between lead exposure, reproductive hormones, and its associated reproductive toxicity.

### 003. Pediatric Risk of Mortality-III (PRISM III) and Pediatric Index of Mortality (PIM3) Scores among Pediatric Poisonings

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**Background**: The Pediatric Risk of Mortality-III (PRISM III) and the Pediatric Index of Mortality (PIM3) scores are commonly used in pediatric critical care as a measure of severity of illness as well as risk of mortality. However, it's unclear if these scores adequately predict outcomes specifically for poisonings.

**Research Question**: What is the association of PRISM III and PIM3 scores with mortality and length of stay (LOS) among pediatric patients in the Pediatric Intensive Care Unit (PICU)?

**Methods**: Data consisted of all poisonings from the Virtual Pediatric System (VPS, LLC) from years 2019-2021. VPS is a multi-institutional database supporting comparative analysis of PICU management and outcomes. PRISM III and PIM3 probability of mortality scores were used. Multivariable logistic and log-linear regression analyses were separately conducted for each outcome (PICU mortality, PICU LOS, hospital LOS) for overall poisonings and by poisoning type (opioids, acetaminophen, antidepressants, stimulants, cardiovascular agents). Area under the curve (AUC) values were used to assess discrimination for PRISM III and PIM3.

**Results**: Among a sample of all poisonings ($N$=29,595), each additional percentage increase in PRISM III was associated with a 7% higher odds of PICU mortality (OR 1.07; 95% CI: 1.07, 1.08). Each additional percentage increase in PIM3 was also associated with a 8% higher odds of PICU mortality (OR 1.08; 95% CI: 1.01, 1.16). The AUC was 0.876 for PIM and 0.886 for PRISM III, reflecting adequate discrimination for the two measures. Higher PRISM III and PIM3 probabilities were associated with longer PICU and hospital LOS for overall poisonings. This also held true within certain types of poisonings (opioid, acetaminophen, antidepressant, and cardiovascular), but not for stimulants.

**Conclusion**: Higher PRISM III and PIM3 scores are predictive of higher mortality and longer LOS among pediatric poisonings in PICUs, with the exception of stimulant poisonings.

***ToxIC: This research was performed in collaboration with the ACMT Toxicology Investigators Consortium***

### 004. Can We Predict the Next "Benadryl Challenge?" A Side-by-Side Comparison of RADARS® Web Monitoring and NPDS Data

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**Background:** The "Benadryl Challenge" propagated by social media in 2020 resulted in adolescents ingesting toxic doses of diphenhydramine, and at least one associated fatality. Dangerous internet fads such as this continue. The Researched Abuse, Diversion and Addiction-Related Surveillance (RADARS®) Web Monitoring Program surveys the internet for mentions of xenobiotics and observes frequency spikes which may uncover new trends in medication misuse or abuse.

**Research Question:** The purpose of this study is to determine temporally how detection of diphenhydramine ingestion trends in the RADARS® Web Monitoring Program compares to the National Poison Data System (NPDS).

**Methods:** This is a retrospective study analyzing the RADARS® Web Monitoring Program database of publicly available internet posts on Twitter, blogs, forums, and news articles. Search terms included "benadryl challenge," "benadryl challenge," "benadryl trip," and/or "benadryl trip"

from July 1 to December 31, 2020. Descriptive statistics were used to compare this to 2020 NPDS primary diphenhydramine ingestions by age group.
**Results:** We observed a peak frequency of 1,904 term mentions from 8/31 to 9/6/20 compared to an average of nine mentions per week from 8/1 to 8/30/20. NPDS data demonstrate that there were 2,171 reported diphenhydramine ingestions among 13-19 year-olds from 9/1 to 10/31/20. This represents a 16% increase over the mean (1,873) of the three preceding two-month periods.
**Conclusion:** The RADARS® Web Monitoring Program was able to identify a significant spike in internet mentions of the "Benadryl Challenge" in early September, 2020, which preceded an observable increase in adolescent diphenhydramine ingestions reported to poison centers in September and October, 2020. While not definitive, web monitoring may be a useful tool for predicting trends in medication misuse and could help guide public health messaging, education, and resource allocation.

**Day 1: Moderated Posters, Abstracts 005-011**

### 005. Medical Toxicology Consultations for Poisoned Children Managed in Pediatric Intensive Care Units

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**Background**: Drug overdose and poisoning ("poisoning") increased by 83.6% from 2019 to 2020 among children and adolescents, becoming the third leading cause of death in that age group. Medical toxicologists (MTs) are specially trained to treat children with poisoning, commonly managed in Pediatric Intensive Care Units (PICUs). MT consultation is not available in all PICUs.
**Research Question**: What is the association between MT consultation and outcomes for poisoned PICU patients?
**Methods**: Virtual Pediatric System (VPS) is a multi-institutional database supporting comparative analysis of PICU management and outcomes. Data from years 2019-2021 on poisonings were included in this analysis. MT consultations were operationalized as a binary variable (yes/no). The comparison group consisted of cases without MT access at their hospital. Multivariable logistic regression analyses were used to determine the association between MT consultations and mortality, adjusting for age, sex at birth, race/ethnicity, PRISM III scores, and trauma (yes or no). Log-linear regression analyses were used to examine the association between MT consultations and PICU length of stay (LOS). All analyses were conducted in R 4.1.2.
**Results**: The analytic sample included 1,792 (11.2%) poisoned patients who received MT consultations and 14,205 (88.8%) poisoned patients without MT access. Patients who received MT consultations had a slightly higher PRISM III probability of mortality (median=0.43) compared to patients without MT access (median=0.34) ($p < 0.001$). In the multivariable model, MT consultations were associated with a 66% lower odds of mortality compared to those without MT access (OR: 0.34; 95% CI: 0.15, 0.77), after adjusting for covariates. Additionally, MT consultations were associated with a 18% shorter PICU LOS compared to patients without MT access (Estimate: -0.20; 95% CI: -0.26, -0.14).
**Conclusion**: VPS data analyses determined that MT consultation for poisoned PICU patients is associated with a reduction in mortality and shorter LOS.

***ToxIC: This research was performed in collaboration with the ACMT Toxicology Investigators Consortium***

### 006. Analysis of Interventions Required in Pediatric Patients with Acute Intoxications Admitted to the Phoenix Children's PICU

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**Background:** Acute intoxications in children account for ~5% of annual Pediatric Intensive Care Unit (PICU) admissions in the USA, while only about 30% of these admissions require any advanced interventions. In a healthcare environment where there is a shortage of critical care pediatric beds, or where responsible fiscal management is essential, having a better understanding of appropriate allocation of patients with acute intoxications is beneficial.
**Hypothesis:** Most pediatric patients with acute intoxications admitted to the Phoenix Children's (PC) PICU require PICU-level interventions.
**Methods:** This was a retrospective chart review of all PICU admissions for patients less than or equal to 18 years of age with a diagnosis of acute intoxication, poisoning, ingestion, or overdose during the period July 1st, 2014, to June 30th, 2020. Patient charts were evaluated to determine patient demographics, toxicants, toxicant effects, interventions, necessary monitoring, and outcomes. Data were summarized using frequencies and proportions for categorical variables

and mean, standard deviation, median, first/third quartiles, and range for continuous data.
**Results:** In total, 497 patient admissions (0.4%) met study criteria, 56% being female. Median age was 3.00 years (interquartile range, 1.50 – 14.00). Median PICU length of stay was 2.00 days (range, 1.00 – 18.00). Of these patients, 25.8% had intentional intoxications; the remainder were classified as accidental. The most frequently encountered toxicants were unknown substances (11.1%), detergents/degreasers/cleaning substances (9.5%), opioid analgesics (7.8%), and antihistamines (6.2%). In all, one patient died and only 10% of total cases required PICU-level interventions.
**Conclusion:** After review of all eligible PICU cases with acute intoxication, 90% did not require an ICU-level intervention. Most of these cases could seemingly have been managed on the medical floor, liberalizing PICU space and improving fiscal management. Future research should consider the impact of such a change on patient safety and hospital staffing.

### 007. Frequency of Critical Care Interventions by Mechanism of Action in Pediatric Anti-Epileptic Drug Overdose

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**Background:** Anti-epileptic drugs (AEDs) are commonly prescribed to pediatric patients for both primary seizure prophylaxis as well as psychiatric indications. AED overdoses are associated with a wide range of toxicity, which is dependent on the mechanism of action (MOA) of the specific drug. Hypothesis: Pediatric exposures to AEDs with sodium-channel blockade require critical care interventions (CCIs) more frequently than exposures to other AEDs.
**Methods:** We performed a cross-sectional analysis of single-agent pediatric (0-19 years) AED exposures reported to the Toxicologic Investigators Consortium (ToxIC) database between 2010-2020. AEDs were sorted by MOA and compared to a composite measure of CCIs. This measure included vasopressors, endotracheal intubation, renal replacement therapy, gastric lavage, whole bowel irrigation, and hemodynamic measures such as mechanical cardiac pacing or extracorporeal circulatory support. Descriptive statistics were used to describe the cohort. Chi-squared test was used to compare drug-classes and CCIs.
**Results:** 497 AED exposures were identified, with 41 (8.2%) requiring CCIs. The majority of exposures ($n = 298$; 60.0%) were female. The median exposures per year was 49 (IQR 33-56.5), with a peak incidence of 71 exposures in 2014. Lamotrigine ($n = 101$), clonazepam ($n = 86$), and carbamazepine ($n = 84$) were the most common exposures; lamotrigine (14/101) and carbamazepine (14/84) required the most CCIs. AEDs with sodium-channel blockade ($n = 240$) had the highest proportion (33/240; 13.8%) of CCIs and were more likely to require CCIs compared to agents with all other primary mechanisms of action (8/257, 3.1%), $\chi 2$ (1) = 18.6, $p < 0.001$. Valproic acid ($n = 68$) accounted for the largest proportion (5/8; 62.5%) of CCIs among non-sodium channel blocking agents.
**Conclusion:** Exposures to AEDs with sodium-channel blockade carry a higher probability of requiring CCIs than exposures to agents with no sodium-channel blockade. Clinicians should consider these risks in the determination of monitoring recommendations and disposition for patients poisoned with AEDs.

***ToxIC: This research was performed in collaboration with the ACMT Toxicology Investigators Consortium***

### 008. Cannabis Edible Toxicity in Children: Defining a Toxic Dose

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**Background:** Cannabis edible exposures have increased with legalization. Understanding the tetrahydrocannabinol (THC) dose leading to severe symptoms has implications for medical management and regulations.
**Hypothesis:** THC mg/kg dose can predict duration and symptom severity in children.
**Methods:** A retrospective review within a children's hospital network where recreational cannabis is legal (01/01/2015 - 06/15/2022) was conducted. Edible ingestions in patients < 6 years were identified (ICD codes F12, T40.7X) and included if dose was known. Severe signs and symptoms were defined as: dysrhythmia, bradycardia, hypotension/sinus tachycardia requiring interventions, receiving sedatives, seizure/myoclonic jerks, significant sedation, intubation/respiratory failure/apnea, or oxygen support. Logistic regression and receiver operative curve (ROC) were performed to predict severe signs and symptoms and duration > 8 hours.
**Results:** Sixty-six cases were analyzed. Median age was 2.95 years (IQR 1.6). THC dosing ranged 0.2 to 69 mg/kg (median 2.083 mg/kg, IQR 4.33). Thirty patients had severe signs and symptoms (45%, 95% CI: 34%, 57%): 29 involved a dose >/= 2 mg/kg. Dose ($p < 0.001$) and age ($p < 0.05$) were significant predictors of signs and symptoms > 8 hours with odds increase of 2.03 per 1 mg/kg THC increase

(95%CI: 1.34, 3.1). Dose was significant ($p < 0.0001$) in predicting severe signs and symptoms with odds increase of 2.8 per 1 mg/kg THC increase (95% CI: 1.72, 4.62). ROC demonstrated 2.33 mg/kg had sensitivity/specificity of 90%/73% for severe signs and symptoms (AUC 91.9%); for duration > 8 hours (AUC 84.7%), 1.72 mg/kg had a sensitivity/specificity of 86%/63%.

**Conclusion:** Edible ingestions exceeding 1.72 and 2.33 mg/kg were associated with prolonged and severe signs and symptoms in children < 6 years, respectively. These findings support healthcare providers and poison centers with management decisions. These thresholds help inform regulators on dose limitations for cannabis edibles in legal markets.

### 009. Cannabis Legalization and Unintentional Pediatric Poisonings: a Population-based, Repeated Cross-sectional Study

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**Background**: Canada legalized cannabis in October 2018 but initially prohibited the sale of edibles. Starting in January 2020 some provinces permitted the sale of commercial cannabis edibles. Question: What are the effects of cannabis legalization edibles on pediatric poisoning?

**Methods**: We examined changes in hospitalizations for cannabis poisoning and all-cause poisoning, in children <10 years over three legalization policy periods in Canada's four most populous (total 3.4 million children) provinces. We conducted a repeated cross-sectional population-level study of all pediatric hospitalizations in Ontario, Alberta, British Columbia, and Quebec. Exposure periods: Pre-legalization (January 2015 – September 2018), period one in which dried flower only was legalized in all provinces (October 2018 – December 2019), and period two, in which edibles were legalized in three provinces (exposed provinces) and restricted in one province (control province) (January 2020 – September 2021).

**Results**: During the seven-year study period, there were 581 hospitalizations for cannabis poisoning (53.9% male; mean age 3.6 years) and 4,406 hospitalizations for all-cause poisonings. Overall, pediatric hospitalizations for cannabis poisoning increased 6.3-fold. Out of all poisonings, the proportion of cannabis poisoning hospitalizations pre-legalization was 5.7% in the exposed provinces and 3.8% in the control provinces. During period one, the proportion increased to 15.0% in the exposed provinces (incidence rate ratio [IRR] 2.55; 95% CI 1.88-3.46) and to 11.8% in the control province (IRR 3.05; 95% CI 1.82-5.11). During period two, the proportion of poisoning hospitalizations due to cannabis more than doubled to 31.8% in the exposed provinces (IRR 2.16; 95% CI 1.68-2.80) but remained similar at 13.8% in the control province (IRR 1.18; 95% CI 0.71-1.97).

**Conclusion**: Following legalization, cannabis edible sales were associated with increases in pediatric hospitalizations for poisonings. In jurisdictions with legalized edibles, almost one in three pediatric hospitalizations for poisoning are due to recreational cannabis.

### 010. Pediatric Rattlesnake Envenomations Treated with Crotalidae Equine Immune F(ab')$_2$ Antivenom: A 3-Year Retrospective Observational Analysis

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**Background:** Rattlesnake envenomations are uncommon and the majority occur in adults. Though Crotalidae equine immune F(ab')$_2$ antivenom (F(ab')$_2$AV; trade name ANAVIP®) was introduced in 2018, no pediatric specific studies of F(ab')$_2$AV have been reported to date.

**Hypothesis:** F(ab')$_2$AV is well tolerated in pediatric patients.

**Methods:** A single center, retrospective chart review was performed on patients with rattlesnake envenomations presenting to a children's hospital between October 2018 and August 2022. Inclusion criteria were age less than 18 years and F(ab')$_2$AV use. Exclusion criteria were other antivenom use at any time and presentation beyond 24 hours. Demographic characteristics, hemoglobin, platelet count, fibrinogen, and INR, number of F(ab')$_2$AV vials used, infusion-related complications, and clinical outcomes were collected.

**Results:** Twenty-six patients, 19 males and seven females, with a mean age of 7.7 years (0.67-16 years) met inclusion criteria. 14 (54%) required only the initial 10 vial F(ab')$_2$AV dose. 12 patients required additional doses with a mean additional vials given of 10.5 (4-34 vials). The mean total vials given for all patients was 15.7 (10-44 vials). Two patients developed acute infusion reactions. Both were treated by slowing the infusion rate and with medications (diphenhydramine, corticosteroids). No delayed reactions were noted. No patients required blood products or surgical interventions. Following discharge, no complications, recurrent symptoms, return visits, or readmissions were reported.

Post-discharge follow up by chart review or phone was obtained for 18 patients, and no complications were noted. Seven patients had post-discharge hematologic laboratory evaluations, and all were normal.
**Conclusions:** Though limited by small sample size and post-discharge follow-up, $F(ab')_2AV$ was well tolerated in our series of pediatric patients, consistent with prior studies of all age groups.

### 011. Analysis of New York City Heavy Metal Testing of Consumer Products

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**Background:** Though some heavy metals are necessary for life, others are harmful in exposure or ingestion. This project was designed to analyze the findings of the New York City Department of Health and Mental Hygiene's heavy metal testing of consumer products.
**Research question:** Do consumer products contain excessive heavy metals?
**Methods:** The dataset "Metal Content of Consumer Products Tested by the NYC Health Department" was analyzed using Microsoft Excel. The dataset contained testing of 6073 products. Data regarding guidance for maximum acceptable concentration of heavy metals were obtained from the FDA.
**Results:** Of the 6073 products tested from 2011-2021, 2878 (47.4%) contained measurable amounts of heavy metals (lead, arsenic, mercury, cadmium, and chromium). Cadmium and chromium were detected in only one product each and were excluded from further analysis, as were 246 products with data not recorded in ppm. Arsenic: 112 products; 97.3% dietary supplements, 2.6% spices. All products were over the 100 ppb limit. Lead: 2293 products; 50.5% spices, 12.4% dietary supplements, 10.2% toys. 100% of candy and other foods, 99.8% of spices, and 99.6% of dietary supplements were above the 0.1ppm limit for ingested substances; 68.4% of cosmetics were above the limit of 10 ppm. Mercury: 225 products; 70.7% dietary supplements, 28.4% cosmetics. 60.9% of cosmetics and 60.0% of dietary supplements were above the 1 ppm limit.
**Conclusion:** Nearly half of tested products contained measurable amounts of heavy metals, and of these many contained a greater than recommended amount of the metal in relation to an approximate reference standard. Dietary supplements and spices represent a common source of contamination, and dietary supplements in particular are often used by patients without discussion with a physician. This data highlights another reason it is important to discuss dietary supplement use with patients and to caution patients about the use of unregulated products.
**Day 1: Posters, Abstracts 012-071**

### 012. Massive Isolated Topiramate Ingestion with Marked Improvement after Hemodialysis

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**Background:** Though topiramate is dialyzable, there are no clear consensus guidelines on when hemodialysis (HD) is indicated. A recent review of the literature identifies 29 topiramate overdoses, however dialysis was rarely performed, co-ingestions were common, and many levels were only modestly elevated or not available. What parameters should trigger the decision to dialyze a patient in the setting of massive ingestion of topiramate?
**Methods:** This is a case study of a 32-year-old female with an intentional ingestion of 36 g of topiramate. The patient was evaluated by the toxicology service 24 hours after presentation to the ED. She had progressive non-anion gap metabolic acidosis, decreased level of consciousness with minimal response to painful stimuli, and abnormal myoclonic jerking of the extremities and facial muscles. In addition to toxicology, neurology and nephrology were also consulted. Neurology recommenced transfer for electroencephalography (EEG) to rule out focal seizures because EEG was not available at the treating facility. Unfortunately, timely transfer was not possible because the receiving hospital was at capacity. The decision to dialyze the patient at the current facility was made due to the significant ongoing encephalopathy.
**Results:** After receiving HD, the patient had marked improvement in encephalopathic features; She was alert and oriented to person, place, and time and myoclonic jerking ceased. Topiramate levels before and after HD were 220.0 mcg/mL and 97.7 mcg/mL, respectively. GC/MS showed topiramate only.
**Conclusion:** Dialysis effectively lowered the serum levels of topiramate, which correlated with significant clinical improvement. Dialysis likely prevented an unnecessary patient transfer to another facility. Further data is needed

to establish reliable guidelines regarding HD in the setting of topiramate intoxication.

### 013. Patience is Prudent: a Case Report of Unusual Phenytoin Toxicokinetics from Fosphenytoin

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**Background:** Phenytoin is well known to exhibit Michaelis-Menten pharmacokinetics, switching from first-order to zero-order kinetics at concentrations greater than 10 mg/L. However, phenytoin has been reported to display even slower metabolism at the onset of toxic concentrations often depicted as a plateau, followed by expected zero-order metabolism. This has often been attributed to ongoing absorption from oral ingestions. We present a case report of this phenomenon following intravenous fosphenytoin administration one day earlier.
**Case Report:** A 37-year-old, 79 kg man presented to the Emergency Department (ED) for a supratherapeutic phenytoin concentration after receiving an intravenous loading dose of fosphenytoin 1000 mg PE the day before. Fosphenytoin is a prodrug that is metabolized to phenytoin with a conversion half-life of 15 min after IV administration. Prior to this loading dose, his phenytoin concentration was undetectable. A phenytoin concentration two hours after the fosphenytoin dose was 45.8 mg/L (therapeutic range: 10 – 20 mg/L). A second concentration 21 hours later was 44 mg/L. The poison center (PC) was contacted for help with management. The patient was asymptomatic with an unremarkable physical examination. His triage vitals were: BP, 131/86; HR, 76 beats/minute; RR, 17 breaths/minute; T, 97 degrees Fahrenheit; O2 Sat, 98% on room air. The PC recommended monitoring serial phenytoin concentrations as an outpatient. Over the next five days, the phenytoin concentrations decreased in zero-order fashion: 38.5 mg/L at 29 hours, 28.3 mg/L at 57 hours, 21.7 mg/L at 82 hours and 17.6 at 132 hours.
**Conclusion:** Phenytoin demonstrates Michaelis-Menten pharmacokinetics above serum concentrations of ten mg/L. At concentrations above 40 mg/L phenytoin, metabolism seems to be stalled initially. Although often attributed to ongoing oral absorption, this case suggests another explanation and may be due to changes in tissue binding or adaptation.

### 014. Treatment of Phenytoin Poisoning by Medical Toxicologists

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**Background:** In 2015, the Extracorporeal Treatments in Poisoning (EXTRIP) workgroup published guidelines indicating hemodialysis can be used in certain patients with severe phenytoin poisoning. It is unknown how medical toxicologists have since implemented these recommendations.
**Research Question:** We sought to characterize the key features of phenytoin poisoning cases submitted to the Toxicology Investigators Consortium (ToxIC) database and to identify factors associated with hemodialysis use.
**Methods:** This is a descriptive study of phenytoin poisoned patients and their treatment by medical toxicologists from January 2016 to October 2022 using the ToxIC database. Cases were excluded if there were no signs/symptoms or if symptoms were deemed unlikely to be related to a toxicologic exposure. Pearson Chi-Square and Fisher's Exact tests were used where appropriate to assess for significant associations.
**Results:** We analyzed 178 cases. Phenytoin was the primary agent in 92.1% of patients. Most ingestions involved therapeutic use (41.0%) or were unintentional (27.0%), as compared to attempted self-harm (18.5%). Common symptoms were coma/central nervous system (CNS) depression (33.1%), ataxia (30.3%), nystagmus (14.0%), and seizures (9.6%). Toxicological treatment such as decontamination, elimination therapy, or nonpharmacologic support (including intubation) was given in 47.8% of cases. In total, five patients (2.8%) received hemodialysis for toxin removal. Overall mortality was low at 1.1% ($n$ = two).Patients with CNS depression ($p = 0.004$), who were intubated ($p = <0.001$), and/or required ICU admission ($p = <0.001$) were all significantly more likely to be treated with hemodialysis. Report of phenytoin as a primary agent was associated with higher rates of ICU admission ($p = 0.014$) but not with more frequent CNS depression, intubation, or hemodialysis use.
**Conclusion:** Phenytoin-poisoned patients are rarely treated with hemodialysis. Factors suggestive of more clinically severe toxicity such as CNS depression, intubation, and ICU admission are associated with hemodialysis.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 015. Severe Phenytoin Toxicity Treated with Intermittent Hemodialysis

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**Background:** Although phenytoin has a volume distribution of 0.5 to 0.8 L/kg in the serum, it is highly protein bound. Therefore, the use of hemodialysis to treat phenytoin toxicity has been controversial as its utility and benefit in improving phenytoin removal is unclear.
**Research Question:** What is the rate of phenytoin elimination before, during, and after hemodialysis in a patient with phenytoin toxicity?
**Methods:** This was a single patient chart review of a patient with phenytoin toxicity. Phenytoin concentrations, both bound and free, were serially collected during the patient's hospitalization. Rates of elimination for the period before, during, and after hemodialysis were calculated using a simple regression.
**Results:** A 56-year-old male with epilepsy presented to the emergency department (ED) with ataxia, confusion, and falls. His sister reported he had been taking his phenytoin as directed. Vital signs were normal upon presentation to the ED, but he was disoriented and confused with ataxic movements and bilateral lateral-gaze nystagmus. Frontal bone bossing and gingival hyperplasia were present. Phenytoin levels, both bound and free, were gathered at several time points during the patient's hospital stay. Initial total phenytoin level was found to be 76.0 mcg/mL. At hour seventeen of admission, after IV fluid hydration, total phenytoin remained significantly elevated at 65.0 mcg/mL. After two sessions of hemodialysis, the patient's mental status improved and his phenytoin concentration decreased to 32.6 mcg/mL. Average elimination rate by simple regression analysis of the time periods before hemodialysis, during hemodialysis, and after dialysis were 0.68, 0.88, and 0.22 mcg/ml/hr, respectively.
**Conclusion:** Despite phenytoin being highly protein bound, phenytoin clearance appeared to be higher during the two day time period while the patient was undergoing hemodialysis than in the periods before or after dialysis.

## 016. National Trends in Bupropion Exposures Reported to the United States Poison Centers

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**Background:** Bupropion sales remain robust in the United States (U.S.), with ~23 million prescriptions in 2011 increasing to ~29 million in 2020. Medical toxicologists often are called to care for bupropion overdoses.
**Research Question:** Have bupropion exposures reported to U.S. poison centers (PCs) increased proportionally to prescriptions and are those exposure outcomes significant?
**Methods:** The National Poison Data System (NPDS) was queried for bupropion exposures reported to U.S. PCs from 2011 to 2021. We identified and descriptively assessed the relevant demographic and clinical characteristics. Poisson regression models were used to evaluate the trends in the number and rates (per 100,000 human exposure calls) of bupropion exposures.
**Results:** There were 148,210 bupropion exposures (48.1% were single substance) reported during the study period; 53.1% from acute care hospitals. Ages between 20-29 years (29.1%) constituted the most common age group. Teenage exposures (13 – 19 years) increased during the study period (15.7% to 18.7%). Females accounted for 62.8%. Ingestion was the most common route of exposure, followed by inhalational misuse. The most frequently co-occurring substances were other antidepressants (35.1%) and atypical antipsychotics (16.2%). Suspected suicides (48.3%) and therapeutic errors (30.1%) were the most common call reasons. Major effects were encountered in 9.6% with 0.6% case fatality rate; 27% of cases were admitted to the critical care unit. Intravenous fluids and benzodiazepines were the most frequently used therapy. Agitation and drowsiness/lethargy were the most common clinical effects. During the study period the frequency and rate of bupropion exposures increased by approximately 87% and 91%, respectively.
**Conclusions:** Bupropion exposures increased significantly over the study period. This is greater than can be attributed to the increase in number of prescriptions. Intentional exposure through suicide attempt was common. Many required admission to critical care units. Risk reduction strategies should be formulated to address this growing problem.

### 017. Bilateral Lower Limb Compartment Syndromes Resulting from Neuroleptic Malignant Syndrome

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**Background**: Neuroleptic malignant syndrome (NMS) is an uncommon but potentially fatal syndrome secondary to the use of antipsychotics. It is characterized by muscular rigidity, rhabdomyolysis, fever, and autonomic dysfunction.Severe rhabdomyolysis can lead to rising pressures in peripheral fascial compartments. We describe an unusual case of a patient with neuroleptic malignant syndrome who developed bilateral lower extremity compartment syndrome.
**Methods**: A 24-year-old male on olanzapine, fluphenazine, clozapine, and quetiapine presented to the emergency department with undifferentiated altered mental status and complained of bilateral leg pain. During ED course, he developed fever with CK levels rising up to > 42,670 consistent with rhabdomyolysis, and findings suspicious for tense lower limb anterolateral compartments.
**Results**: He was treated for NMS with propofol and benzodiazepines. He underwent four compartment bilateral fasciotomies for his bilateral lower extremity compartment syndrome. He required several sessions of hemodialysis but recovered and was eventually trialed on quetiapine and discharged to rehab.
**Conclusion**: Compartment syndrome, although rare, is an important complication of neuroleptic malignant syndrome and should be considered in all patients presenting with this rare condition. A high index of suspicion can aid in early recognition and treatment in order to prevent long-term complications.

### 018. Prolonged Serotonin Toxicity after Massive Duloxetine Overdose

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**Background:** Duloxetine is a second-generation serotonin-norepinephrine reuptake inhibitor prescribed for treatment of both psychiatric disorders and neuropathic pain. Duloxetine overdose overall is uncommon, with a total of 6281 cases involving the drug reported in 2020 by the American Association of Poison Control Centers. Survival after massive overdose has previously been reported, however prior case reviews have typically described resolution of symptoms within 24 hours.
**Methods:** This is a case report obtained via retrospective chart review.
**Results:** A 74-year-old female who presented to the emergency department after intentional ingestion of an unknown quantity of duloxetine and cephalexin. After an unremarkable initial workup, the patient was admitted medically for observation. She was noted by the hospitalist team 13 hours after ingestion to have mild generalized tremors and nystagmus. The next day the patient developed severe agitation, jerking body movements, and worsening horizontal nystagmus. After not responding to initial therapy, psychology and neurology were consulted. Ultimately, the patient was diagnosed with opsoclonus-myoclonus syndrome secondary to serotonin toxicity 64 hours after her initial ingestion. A duloxetine level was drawn 81 hours post-ingestion and returned a serum level of 3300 ng/mL. The majority of the patient's neurologic symptoms resolved five days after her admission.
**Conclusions:** This case highlights the potential for both delayed onset as well as prolonged serotonin toxicity in cases of massive duloxetine overdose. Few case reports outside of postmortem studies have identified serum concentrations above 2000 ng/mL. This patient's level returned at 3300 ng/mL more than three days after her initial ingestion. Several mechanisms may have delayed clearance and prolonged toxicity in this case including delayed absorption secondary to diabetic gastroparesis, inhibition of CYP2D6 by duloxetine, and reversal of CYP1A2 induction by smoking cessation upon admission.

### 019. Single Substance Ingestions of Citalopram Versus Escitalopram Reported to U.S Poison Centers from 2010-2022

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**Background:** Citalopram and escitalopram are among the most commonly prescribed selective serotonin reuptake inhibitors worldwide. Previous research presents conflicting data regarding toxicity between these two enantiomers.
**Research Question:** Are there meaningful differences in toxicity after single substance ingestions of citalopram versus escitalopram?
**Methods:** We conducted a retrospective review of the National Poison Data System (NPDS) database from 2010-2022 for intentional single substance ingestions of citalopram or escitalopram among adults (age ≥ 20 years). We compared medical outcomes and the incidences of seizure, tachycardia, and ECG changes. We used Pearson's

Chi-square test to assess differences in clinical effects and medical outcomes between citalopram and escitalopram.
**Results:** There were 12,338 citalopram and 10,385 escitalopram intentional single substance ingestions reported to the NPDS. Statistical significance in outcome severity and incidences of seizure, tachycardia, and ECG changes were observed. Death or major effect resulted in 4.4% ($n = 431$) of citalopram exposures compared to 2.2% ($n = 170$) with escitalopram ($p < 0.001$). Seizure developed in 6.1% ($n = 749$) of citalopram ingestions compared to 1% ($n = 105$) from escitalopram ($p < 0.001$). Tachycardia occurred in 19.6% (n = 2422) of citalopram ingestions compared to 17.2% ($n = 1790$) with escitalopram ($p < 0.001$). Before 2019, QRS, QT and PR abnormalities were coded collectively as conduction disturbances. Between 2010 and 2018, 7.4% ($n = 741$) of citalopram ingestions resulted in conduction disturbances compared to 6.5% ($n = 396$) with escitalopram ($p = 0.024$). QTc interval data in the NPDS database became available in 2019. Since 2019, 13.4% ($n = 317$) of citalopram exposures had QT prolongation compared to 11.3% ($n = 503$) from escitalopram ($p = 0.009$).
**Conclusion:** Death or major effect were more than twice as common after intentional single substance ingestions of citalopram compared to escitalopram. Citalopram was associated with statistically significant higher rates of seizure, tachycardia, and ECG changes. This data suggests a higher risk of clinically significant outcomes after isolated citalopram overdose as compared to escitalopram.

## 020. Mobitz I as Manifestation of Acute Lithium Cardiotoxicity

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**Background:** A 13-year-old female presented one hour following an acute overdose of 10 unknown tablets. The tablets were likely obtained from her grandmother's medications. The 12-lead ECG demonstrated the Mobitz I block, a novel manifestation of lithium cardiotoxicity.
**Methods:** This is a single patient case report.
**Results:** Physical examination, vital signs, CBC, and CMP including serum K, Ca, and Mg were unremarkable. Acetaminophen concentration four hours post ingestion was mildly elevated (28 mcg/ml) and well below the treatment threshold. ECG revealed a Mobitz Type I atrioventricular block but was otherwise morphologically normal for the patient's age. No prior ECGs were available for comparison. Serum lithium concentration was noted to be 1.7 mEq/L (0.6-1.2 mEq/L); digoxin and salicylate were not detected in the serum. While admitted on telemetry monitoring the patient continued to have occasional recurrent episodes of Mobitz type I block which lasted for minutes and spontaneously resolved. During each episode the patient remained asymptomatic and normotensive. The patient was treated only with IV fluids and repeat lithium concentration at 14 hours post-ingestion was undetectable. Repeat ECG at 20 hours post-ingestion showed normal sinus rhythm with normal intervals. She was discharged 36 hours after ingestion with an ambulatory cardiac monitor per pediatric cardiology recommendations.
**Conclusion**: Mobitz I atrioventricular block has not, to our knowledge, been described in the setting of lithium exposure. The most common cardiotoxic effects of lithium include QT prolongation, T-wave abnormalities, and to lesser extent SA node dysfunction and ventricular arrhythmias. This case highlights the widely variable potential presentations of lithium cardiotoxicity.

## 021. Massive Verapamil Ingestion With A Second Peak Of Toxicity

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**Background:** Verapamil is a phenylalkylamine calcium-channel blocker that leads to cardiogenic and vasoplegic shock in overdose. Massive ingestions of sustained- or extended-release formulations can lead to bezoar formation and delayed toxicity.
**Hypothesis:** Delayed, acute toxicity can occur with massive ingestions of verapamil despite initial stabilization.
**Methods:** This is a single patient case report managed with bedside toxicology consultation.
**Results:** A 16-year-old girl ingested eighty-eight 240 mg verapamil SR tablets (21.12 g). She presented to a local hospital and was initially hypotensive (76/40 mmHg). She was given an insulin bolus (1U/kg) and started on norepinephrine (0.1 mcg/kg/min) and insulin infusions (1 U/kg/h). A nasogastric tube was placed and polyethylene glycol 3350 was started (1 L/h). She was transferred to a tertiary care hospital and was cannulated onto venoarterial extracorporeal membrane oxygenation (ECMO) 6 h after ingestion. Ten hours after ECMO initiation, her lactate, which had peaked at 4 mmol/L, improved to 1.6 mmol/L. A verapamil concentration obtained 24 h after ingestion was 3100 ng/mL. Despite whole bowel irrigation, the patient had no bowel movements until HD 2 at which point she began to pass pill fragments. Thirty hours after ingestion, the patient's glucose began to rise (peak: 581 mg/dL). During this time the patient decompensated with worsening bradycardia. She lost native cardiac function and was restarted on insulin (titrated to 5 U/kg/h). Her lactate increased to 15 mmol/L,

40 h post-ingestion. Additional vasopressors were started (epinephrine and vasopressin) and the patient's hemodynamics stabilized.
**Conclusion:** With massive ingestions of calcium channel blockers, not only is a protracted course likely, but acute decompensation with a second peak of toxicity is possible. Restoration of stool output may be a leading indicator of impending decompensation.

### 022. Fatal Thrombosis Event Following ECMO Cannulation in Beta Blocker/Calcium Channel Blocker Overdose: a Case Report

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**Background:** Beta blocker (BB) and calcium channel blocker (CCB) toxicity may cause cardiogenic shock and vasoplegia. In severe toxicity, extracorporeal membrane oxygenation (ECMO) may be employed. Complications of ECMO including thrombosis may impede treatment and cause harm to patients.
**Hypothesis:** ECMO is a potentially life-saving intervention in BB/CCB overdose patients refractory to vasopressors, hyperinsulinemia-euglycemic therapy (HIET), and other first-line measures.
**Methods:** This is a single-patient case report. A 61-year-old woman presented to the ED approximately 14 hours after ingesting 900 mg of amlodipine, 2250 mg of atenolol, 1025 mg of hydrochlorothiazide, and 1600 mg of simvastatin in a suicide attempt. The patient was bradycardic on presentation but awake and alert. She received fluids, atropine, calcium, and glucagon for initial stabilization. She required intubation for respiratory failure and became hypotensive, requiring initiation of vasopressors and HIET. A bedside echocardiogram revealed hyperdynamic left ventricular function with an ejection fraction >70%, yet hypotension persisted despite escalating vasopressors. She was then administered methylene blue and lipid emulsion, which temporarily restored hemodynamic stability. Epinephrine was added as a fourth vasopressor; angiotensin II was considered but unavailable. At approximately 23 hours post-ingestion, the decision was made to cannulate onto VA-ECMO via femoral access.
**Results:** A computerized tomography scan of the abdomen post-cannulation revealed complete thrombosis of the abdominal aorta distal to the celiac artery, a lethal event. The patient was withdrawn from supportive measures and died 33 hours post-ingestion.
**Conclusion:** ECMO is typically reserved for severe refractory BB/CCB toxicity but has been associated with survival benefit. The most common complications are acute limb ischemia and bleeding. There is limited data describing the incidence, mechanism, and management of thromboembolic complications with ECMO therapy in the overdose setting. We are not aware of existing reports of ECMO-related aortic thrombosis in the setting of BB/CCB toxicity.

### 023. Association Between High Levels of Serum Creatinine and Development of Heart Blocks in Acute Yellow Oleander (*Thevetia Peruviana*) Poisoning Within the First 24 Hours, Interim Analysis Done in Sri Lanka

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**Background:** All parts of the oleander plant contain a large number of cardiac glycosides. Although some animal studies have revealed pathological changes in kidneys following acute oleander poisoning, the effect on human kidneys is not clear.
**Hypothesis:** Is there an association between serum creatinine (SCr) level and development of heart blocks in acute yellow oleander poisoning patients?
**Method:** A prospective descriptive cohort study was carried out at Teaching Hospital Batticaloa, Sri Lanka, among patients admitted following acute yellow oleander poisoning. The inclusion criteria were presence of any of the following signs: bradycardia(<60 bpm), systolic blood pressure <80mmHg nausea, vomiting, abdominal pain, diarrhea, xanthopsia. Patients were recruited within 2 hours of admission. SCr level was assessed at recruitment and every 6 hours, serial electrocardiograms were done at recruitment and every 4 hours, for 24 hours. Chi-Squared test was performed to find the association between SCr level and development heart blocks. Ethical Clearance for this study was granted by the Ethics Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka.
**Results:** Of the 65 consenting symptomatic patients recruited, 7.69%($n$=5) patients had high SCr levels (>1.35mg/dL). 9.23%($n$=6), 6.15%($n$=4) and 3.08%($n$=2) \ patients developed 1st, 2nd and 3rd degree heart blocks respectively. The incidence of patients with high SCr levels

who developed heart blocks was 60%. There is a significant association between high SCr levels and development of heart blocks in acute yellow oleander poisoning patients within 24 hours of admission (X2(1, $N$=65) =6.2087, $p$=0.0127). In patients who were found to have high SCr, the relative risk of development of heart blocks was 4.0 (95% CI).
**Conclusion:** Monitoring SCr levels during the first 24 hours in acute yellow oleander poisoning is important to identify patients who are at risk of developing heart blocks.

### 024. Neonatal Near Fatal Flecainide Toxicity

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**Introduction:** Flecainide is an antiarrhythmic medication with a narrow therapeutic index and high mortality in overdose. Few cases of flecainide toxicity in neonates and children due to medication error have been reported. We report a case of an accidental flecainide overdose in a neonate in Oman.
**Case description:** A 19-day-old newborn girl developed persistent superior ventricular tachycardia (SVT) after receiving nebulized albuterol for acute bronchitis. After unsuccessful treatment with adenosine, she was given flecainide 5.6 mg orally daily with resolution of the SVT. On day four of admission, the child inadvertently received 100 mg of flecainide due to a dose calculation error. The child developed pulseless ventricular tachycardia requiring cardiopulmonary resuscitation. Sodium bicarbonate IV bolus followed by an infusion was administered. The patient developed two additional episodes of pulseless VT that coincided temporally with two interruptions of the sodium bicarbonate infusion. Echocardiography showed an ejection fraction of 28%. She developed convulsions and her brain ultrasound was normal. Her condition stabilized on day six of admission. Repeated echo showed a normal EF. She was discharged on propranolol and levetiracetam. She was doing well on outpatient follow up.
**Conclusion:** Flecainide is a potentially lethal medication in overdose due to its sodium channel blocking properties. Sodium bicarbonate remains an essential component of treatment.

### 025. Sodium Bicarbonate Treatment for QRS Widening in Bupropion Overdose

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**Background:** Bupropion toxicity prolongs QRS complexes by inhibiting cardiac gap junctions, leading to ventricular dysrhythmias and hypotension. Sodium bicarbonate (SB) is the first-line treatment for QRS widening from sodium channel blockade, but whether SB affects QRS widening in bupropion toxicity is not well studied.
**Hypothesis:** SB narrows QRS complexes in bupropion overdoses.
**Methods:** This is a retrospective cohort study of bupropion overdoses between January 2010 and June 2022 from a clinical data registry of ten hospitals in Massachusetts. Patients 18 years or older with documented bupropion overdose and administration of SB were included. Patients were excluded if no electrocardiogram (ECG) was performed within four hours of SB. The primary outcome was change in QRS duration between pre-SB ECG and the first ECG after SB. Secondary outcomes included the change in QTc after total cumulative SB administration and the change in interval duration per milliequivalent (mEq) of SB administered. Wilcoxon signed-rank testing was performed to evaluate for changes in QRS duration after SB.
**Results:** Of 37 bupropion overdoses identified, 13 cases were included in the final analysis. The median age of patients was 32 years, and 53.9% were male. Six patients had seizures; four patients had hypotension requiring vasopressors. The median QRS and QTc pre-SB were 116 ms and 495 ms, respectively. The median SB dose administered between the first and second ECG was 100 mEq. No patient had a QRS < 100 ms on the second ECG. The median changes in QRS and QTc were -2.0 ms (-0.02 ms/mEq SB) and +7.0 ms (+0.02 ms/mEq SB), respectively. Wilcoxon signed-rank testing did not find a significant decrease in QRS duration after SB administration ($Z = -0.801$; $p$ = NS).
**Conclusion:** Sodium bicarbonate did not significantly decrease QRS duration in this small retrospective cohort of bupropion overdoses.

### 026. Oral Potassium Overdose Causing Cardiac Arrest – A Rare Case

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**Background:** Oral Potassium was widely considered to be relatively safe in patients with normal renal and cardiac function. While overdose can cause hyperkalemia, cardiac arrest is exceedingly rare with few cases reported.

**Methods:** Case report.
**Case Report:** Forty-eight year-old female presented to the emergency department 3 hours after intentional poly-drug ingestion. Patient was able to name the medications but unable to provide the amount. Pill count revealed that potassium chloride ER 1400 mEq (15 mEq/kg), metoprolol XL 500 mg, rivaroxaban 400 mg, and hydroxyzine 500 mg were unaccounted for. On arrival the patient was emotional but otherwise asymptomatic. EKG showed sinus rhythm with HR 73 bpm, QRS 90 ms, and QTc 420 ms. Nine hours after ingestion, the patient had an episode of vomiting, QRS widened to ~180 ms, then developed V. fib arrest for ~20 minutes before ROSC was achieved. During the cardiac arrest, the patient received two rounds of each insulin 5 units, dextrose 25g, calcium chloride 2g, bicarb 50mEq. Patient's labs drawn 1.5 hours before the cardiac arrest subsequently revealed potassium of 8.7 mEq/L with Creatinine of 0.8 mg/dL. After ROSC, the patient was intubated, hypotensive to 82/54, requiring norepinephrine 8 mcg/min. Patient received further insulin /dextrose and furosemide 40 mg. Hemodialysis was initiated 2 hours post arrest for 1 hour before transition to CVVH due to hemodynamics. Potassium improved to 5.8 mEq/L at 18 hours post-ingestion and 3.6 mEq/L by 36 hours post-ingestion. CVVH was discontinued on hospital day 2. Hospital course was complicated by coagulopathy and persistent agitation. Patient eventually recovered and was transferred to psychiatry on hospital day 15 without neurological sequelae.
**Conclusions:** Oral potassium overdose can rarely cause lethal arrhythmia even in patients with normal cardiac and renal function. Diligent monitoring and timely intervention may help mitigate this treatable morbidity. Extracorporeal therapy may be required despite normal renal function.

## 027. Surviving Heart-Break: Nonfatal Sodium Azide-Induced Myopericarditis

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**Background:** Sodium azide (NaN) is a mitochondrial toxin that is often lethal when taken with suicidal intent. NaN-induced cardiomyopathy is a potentially fatal complication associated with the need for advanced cardiac support measures or death. We report a patient who intentionally ingested NaN, developed myopericarditis, and ultimately had a full recovery.
**Methods:** This is a case report. A healthy 31-year-old, 61 kg female lab technician presented after being found unresponsive by her friends. In the emergency department, she was more alert and reported ingesting 0.5 to 2 grams (8.2-32.7 mg/kg) of NaN in an overdose attempt. She complained of vomiting and fatigue. Initial vital signs were: BP, 122/74 mmHg; HR, 94 beats/min; RR 16 breaths/min; T, 98.4 °F; O2 Sat, 97% (room air). An initial ECG demonstrated normal sinus rhythm without ST changes. Initial laboratory values were notable for: a VBG showing a pH 7.30, PCO2 16 mm Hg, and lactate 15.7 mmol/L; high sensitivity troponin (hs-TnT) 50.37 ng/mL (normal < 15).
**Results:** The patient improved symptomatically and her hyperlactatemia resolved over the next 12 hours. However, on hospital day (HOD) 2, she developed chest pain worse when lying flat. At this time, her ECG showed diffuse PR depression and ST segment elevation; hs-TnT continued to rise, peaking at 179 ng/mL. Transthoracic echocardiography revealed an ejection fraction of 50% without a pericardial effusion. She was treated with 0.6 mg colchicine BID and her pain resolved within 24 hours. Her troponin elevation resolved on HOD 3 but ECG changes persisted at last check on HOD 8, when she was transferred to psychiatry.
**Conclusion:** Sodium Azide is a mitochondrial toxin that causes significant morbidity and death following overdose. Providers should be aware of NaN-induced myopericarditis in survivors of NaN overdose.

## 028. Avoiding Rebound Hyperkalemia: Treatment of Severe Hydroxychloroquine Toxicity with Continuous Renal Replacement Therapy during a Diazepam Shortage

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**Background:** Most of what we know about managing Hydroxychloroquine (HCQ) toxicity is extrapolated from chloroquine intoxications. We report a case of severe HCQ toxicity treated with a midazolam infusion and continuous renal replacement therapy (CRRT).
**Method:** An 18-year-old female presented less than an hour after ingesting 6-8 gm of HCQ. Vitals were: HR 70 bpm; BP 67/37 mmHg; RR 18/min; temperature afebrile; oxygen saturation 97% on room air. Initial EKG showed: sinus rhythm; QRS 102 msec; QTc 540 msec. The patient was obtunded, and was intubated, followed by orogastric lavage. She was aggressively resuscitated, and an epinephrine infusion was initiated. While in the ICU, intravenous (IV) diazepam was switched to IV midazolam, on account of a national shortage. Within 7 hours of presentation, she was severely acidotic, with a pH 7.03, and hypokalemic to 1.5 mmol/L, despite aggressive repletion. She was consequently placed on CRRT for 36 hours. Further hospital course was complicated by a seizure-like episode and persistent unexplained

hypoglycemia for which lipid emulsion and octreotide were administered, respectively. She did not develop any QRS prolongation. She was extubated six days later, neurologically intact. The peak serum HCQ level was >5000 ng/mL.
**Result:** Per EXTRIP, HCQ is non-dialyzable but due to limited data, no specific recommendations exist. In our case, CRRT was utilized to mitigate the existing and anticipated metabolic derangements of severe HCQ toxicity. While diazepam is a cornerstone therapy for chloroquine toxicity, a midazolam infusion was utilized out of necessity, and we were able to achieve a good final outcome.
**Conclusion:** CRRT is an efficacious modality to manage the severe acidosis, hypokalemia, and rebound hyperkalemia associated with severe HCQ toxicity without the hemodynamic consequences of hemodialysis. Intravenous midazolam appears to be an efficacious alternative to diazepam when the latter is in short supply.

### 029. Cluster Outbreak of Elemental Mercury Poisoning

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**Background:** Elemental mercury (Hg) is most toxic when inhaled and can cause pneumonitis progressing to pulmonary failure. Once absorbed, it distributes widely into tissues, causing multi-organ dysfunction, favoring retention in the central nervous system.
**Methods:** We report a cluster of elemental mercury exposures at a thermometer factory. Initially, an elderly male presented with respiratory distress requiring intubation. Chest imaging showed ground glass opacities that worsened over 48 hours. Serum and urine Hg were elevated to 373.2 ng/L and 577 mcg/L, respectively. Due to clinical deterioration, ECMO was initiated, and he was chelated with dimercaprol (BAL) and dimercaptosuccinic acid (DMSA). Subsequently, a middle-aged male was admitted with complete heart block requiring a pacemaker; his ischemic workup, including cardiac MRI were unremarkable. However, his serum Hg was 284.3 ng/L; he was chelated as an outpatient with DMSA. Further inquiry led to identification of three additional factory workers who reported non-specific symptoms in the context of elevated blood/urine Hg levels; they were also chelated with DMSA. The index patient recovered from ECMO after 12 days. All patients are being followed in our occupational health clinic. It was determined that these exposures occurred due to a combination of unsafe disposal techniques and improper PPE at their worksite. An OSHA investigation of the site remains ongoing.
**Results:** Large elemental Hg spills require cautious abatement, typically by licensed contractors, state health department, and/or the EPA. There is limited evidence regarding aggressive chelation strategies for significant elemental Hg toxicity. However, BAL and DMSA were successful in our cases.
**Conclusion:** Our cluster of mercury poisonings serve as a public health reminder of the potential dangers of this ancient toxin, and the utility of BAL and DMSA in reducing the total body burden of this metal.

### 030. Extracorporeal Membrane Oxygenation in the Treatment of Acute Inhalational Elemental Mercury Toxicity

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**Background:** Inhalation of elemental mercury is a rare cause for acute respiratory distress syndrome (ARDS). There is evidence emerging suggesting a beneficial role for Extracorporeal Membrane Oxygenation (ECMO). We report a case of ARDS secondary to acute elemental mercury inhalation, successfully treated with ECMO and chelation.
**Method:** A 56-year-old male with a history of diabetes, hypertension, restrictive lung disease secondary to covid pneumonia, presented with dyspnea, cough, and hypoxia to 79% on home pulse oximetry over 24 hours. An occupational history revealed that he was employed at a thermometer factory. Vital signs: HR 91 bpm; BP 142/87 mmHg; RR 33, oxygen saturation of 88% on 6L; temperature 97.8F. Cardiac enzymes, ECG, and an echocardiogram were non-diagnostic for his respiratory failure. CT angiography ruled out pulmonary embolus but showed bilateral upper lung ground glass opacities suggestive of pneumonitis. Despite being treated with steroids and supportive measures, the patient was intubated due to severe ARDS, and was quickly transitioned to VV-ECMO. The serum mercury level was 373.2 µg/L, and a 24-hour urine mercury level was 174 µg/L (heavy metal urine mercury: 577 µg/24 h). Dimercaprol and succimer were administered for 12 days and 19 days, respectively. ECMO was discontinued after 12 days, and he was discharged home on 5L oxygen. Follow up serum mercury levels have decreased to 20.1 µg/L.
**Result:** Early initiation of ECMO improves outcomes of severely poisoned patients when optimal treatment options fail. VV-ECMO provides respiratory support and is primarily used in ARDS patients. To our knowledge, this is the first case of VV-ECMO for the management of pneumonitis due to acute elemental mercury inhalation.
**Conclusion:** ECMO may be used in the management of ARDS due to elemental mercury inhalation. Furthermore,

chelation with succimer and dimercaprol can be successfully performed while a patient is on ECMO.

### 031. Complete Heart Block Secondary to Inhalation of Elemental Mercury

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**Background:** There is only one published case report of acute inhalational mercury (Hg) toxicity associated with third degree heart block. We report the second case of complete heart block (CHB) associated with acute inhalation of elemental Hg in a patient who underwent exhaustive ischemic and non-toxicological workups.
**Method:** A 44-year-old previously healthy male, employed at a Hg thermometer factory, developed exertional dyspnea, chills and body aches three days prior to arrival. Vital signs: HR 50 bpm; BP 156/89 mmHg; RR 20/min; oxygen 98% on room air; temperature 98F. Initial EKG showed CHB at a rate of 49 bpm. Chest X-ray indicated a right upper lung opacity. Serial cardiac enzymes were non-diagnostic, as were Lyme titers, echocardiogram, and cardiac MRI. A permanent pacemaker (PPM) was placed. Screening mercury levels were sent due to the nature of his occupation, and he was discharged in stable condition. Follow-up CT chest reported bilateral upper lung ground glass opacities suggestive of pneumonitis. The patient was rehospitalized for IV steroids. Serum Hg level resulted at 284.3 µg/L, and a 24-hour urine Hg level was 437 µg/L. Intramuscular dimercaprol was initiated but discontinued due to patient discomfort. However, he completed a 19-day course of succimer, after which repeat serum Hg levels had trended down to 56.3 µg/L. A follow-up CT chest showed resolution of the pneumonitis. Three months later, a PPM interrogation showed persistent CHB.
**Result:** The effects of mercury on the cardiac conduction system are not adequately known. Our patient's exhaustive medical workup in the context of an elevated Hg level suggests the possibility of his persistent CHB arising due to inhalation of elemental mercury.
**Conclusion:** Acute inhalation of elemental mercury may provoke CHB, and an accurate occupational/environmental exposure history remains a critical component of a medical workup.

### 032. Severe Persistent Arsenic Toxicity in an Accidental Monosodium Methyl Arsonate (MSMA) Exposure

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**Background:** MSMA is an organic herbicide commonly used on lawns to treat weeds. Prior literature suggests that it causes a low degree of toxicity with temporary neuropathy, and gastrointestinal upset regardless of high urinary concentrations. We present a case of accidental MSMA exposure characterized by severe arsenic toxicity including debilitating neuropathy, and renal failure.
**Methods:** This is a single case report. A 61-year-old male with no past medical history accidentally drank MSMA which had been placed into a whiskey bottle. He developed vomiting, and diarrhea that resolved after one day. After two days he had decreased urine output, and hearing loss prompted him to seek care on the fourth day. He was admitted and found to have a creatinine of 6.7 mg/dL. Toxicology was consulted by the poison center. We recommended obtaining 24 hour urine arsenic levels which resulted as 4,685.6 mcg/dL. He was also started on a 19 day course of succimer as dimercaprol was not available. The patient received an intermittent course of chelation, with interruptions secondary to supply issues. His renal function improved without dialysis. On the 10th day he developed a progressive "stocking glove" neuropathy. Patient was discharged to rehab after several weeks and was seen in our clinic two months later. He continued to have severe neuropathy suffering disability limiting his ADLs.
**Results:** Our patient developed a classic arsenic toxicity from his MSMA exposure felt to be due to his delay in presentation, interrupted chelation, and the liberation of inorganic arsenic. His neuropathy continued to be severe months after exposure with continued difficulty performing ADLs. Timelines for recovery could range from several years to incomplete.
**Conclusion:** MSMA while thought to be low in toxicity with prompt presentation and chelation, can develop into severe and persistent arsenic poisoning if treatment is delayed or interrupted.

### 033. Elemental Mercury Vapor Toxicity Presenting with a Diffuse Rash: a Case Report

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**Background:** Elemental mercury vapor toxicity often presents with classical signs and symptoms owing to pulmonary and neuropsychiatric manifestations; dermatologic findings are rarely reported.
**Methods:** This is a single patient chart review of a seven year-old girl who presented to the emergency department with a fever and rash for one day. Vital signs: BP 115/79,

HR 145/min, Temp 39.5 degrees celsius, RR 28/min, SaO2 93% on RA. Upon presentation she had a symmetric, centrally-distributed morbilliform rash to her face, neck, chest, and proximal upper and lower extremities. She was treated empirically for bacterial infection with vancomycin and doxycycline, with appropriate testing that included tick-borne rickettsial infections. We were consulted on hospital day one (HD1) after discovering that five days prior to presentation the patient was found playing with ten ounces of elemental mercury in the back seat of the family truck. The parents brushed the mercury onto the floor mats and discarded it but continued to use the truck for the next four days.
**Results:** A 24-hour urine mercury was collected on HD4. We provided contact details for a hazardous material cleanup service to have the truck remediated, and the patient was discharged to the care of her parents on HD5. Four days after discharge, the test resulted at 214 mcg/24hrs. The patient was recalled and chelated with a 19-day course of dimercaptosuccinic acid.
**Discussion:** Absent classical signs and symptoms, the diagnosis of elemental mercury toxicity is challenging. Previous case reports have illustrated this diagnostic dilemma, with several patients presenting with rashes, with or without URI symptoms, who were not correctly diagnosed until after multiple visits to care.
**Conclusion:** Elemental mercury vapor toxicity can present atypically with prominent dermatologic findings, making the diagnosis challenging. A high index of suspicion and familiarity with atypical presentations is suggested.

### 034. Metal Pneumonitis from "Non-toxic" Decorative Cake Dust Aspiration

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**Background:** Metallic luster dusts are common decorative agents for cakes and other confections. While some powders are labeled "non-edible", they are also marketed as "non-toxic". There are reports of luster dust ingestions causing heavy metal toxicity and a recent report of three inhalation exposures, including one pediatric case with symptoms typical of metal fume fever that resolved within 48 hours.
**Hypothesis:** Aspirated metallic cake dust can cause metal pneumonitis.
**Methods:** This single-patient chart review involves a four-year-old female who developed hypoxemic and hypercapnic respiratory failure after cake dust aspiration. She presented to the emergency department (ED) tachypneic, with coarse breath sounds, and 88% O2 saturation, shortly after attempting to ingest *Claire Bowman Gold Decorative Metallics* which contains bronze.
**Results:** In the ED, the patient was placed on supplemental oxygen and initial CXR was unremarkable. Despite escalating to high-flow nasal cannula at 1 L/kg/min of 40% oxygen, her mental and respiratory statuses worsened, with pCO2 rising to 58 mmHg 65 minutes after arrival. She was intubated, and a repeat CXR, performed ~188 minutes post-exposure, revealed bilateral patchy perihilar and peribronchial opacities. In the ICU, she received ventilatory support and diuresis with furosemide, but the CXR opacities progressed over the next 48 hours, becoming suspicious for ARDS. She had intermittent fevers and leukocytosis, but antibiotics were deferred. A respiratory viral panel, blood, urine, and sputum cultures were negative. She remained intubated until hospital day (HD) five, requiring supplemental O2 until HD nine. She was discharged home on HD 10.
**Conclusion:** Powdered metallic shavings, including bronze, are indeed toxic. "Non-edible" labeling does not adequately convey the health risks associated with handling by children, as evidenced by this case of metal pneumonitis. Accordingly, "non-toxic" should be abandoned as a descriptor of these products, and consumers made aware of potential risks.

### 035. Elevated Serum and Urine Cobalt Concentrations Associated with Hydroxocobalamin Administration

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**Background:** Hydroxocobalamin has been proven as a safe and effective antidote for cyanide toxicity. Its administration is associated with interference with calorimetric assays but otherwise is not generally associated with significant adverse effects. Here we describe a case of significantly elevated serum and urine cobalt levels following administration of hydroxocobalamin for metabolic acidosis of unclear etiology.
**Methods:** This is a single case review. A 60 year old female with no previously identified medical history presented to the emergency department with altered mentation, generalized weakness that had been progressively worsening over the course of several months. Laboratory evaluation was remarkable for metabolic acidosis with markedly elevated lactate that rapidly rose over the course of her ED stay, prompting concern for cyanide toxicity and subsequent hydroxocobalamin administration with subsequent improvement in lactate concentrations. Patient underwent broad evaluation for precipitating etiology including heavy

metals testing (obtained 24 hours after admission), revealing a serum cobalt concentration of > 1000 mcg/L. Repeat serum testing 7 days later showed a cobalt level of 368.4 mcg/L, spot urine testing showed a urine cobalt level of 3035.6 mcg/L. Throughout the patient's hospitalization there were no identified exposures to cobalt, the patient had no implantable medical devices. She demonstrated no polycythemia, evidence of hypothyroidism or cardiomyopathy or sensory myopathy.
**Discussion:** Hydroxocobalamin has proven to be a safe and effective antidote for cyanide toxicity but has been associated with laboratory interference due to its bright magenta color; although elevations in urine cobalt concentrations have been described, serum elevations are not routinely reported in the literature. This is thought to be due to the cobalt atom at the core of the hydroxocobalamin molecule. Similar results have been noted in animal studies but not well described in human cases.
**Conclusion:** Administration of hydroxocobalamin can result in elevated serum/ urine cobalt levels after its administration.

### 036. Case Series of Three Mothers with Elevated Blood Lead Levels and Breast Milk Lead Concentrations

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**Background:** Lead can be transferred from exposed mothers to babies in utero and through breast milk. Elevated blood lead levels (BLL) have been correlated with adverse neurodevelopmental outcomes and developing babies are among the most susceptible. This burden is disproportionately borne by exposed children in high-risk groups, including lower socioeconomic status and immigrant children. To address this risk, our team measures prenatal and neonatal lead and mercury levels in mother-baby dyads. When maternal BLL is ≥ 40 mcg/dL breastfeeding is not recommended and obtaining routine breast milk lead concentrations (BMLC) is not recommended.
**Methods**: This case series includes three mothers, two were identified prospectively through the noted screening procedures, and the third was identified at another facility through routine prenatal screening. Case one: A mother with a BLL of 49.5 micrograms/dL at time of delivery had a BMLC collected. Case two: A mother with a BLL of 70.2 micrograms/dL at time of delivery had a BMLC collected. Case three: New Jersey Poison Information and Education System was consulted when a 33-week pregnant patient was found to have a BLL of 76 mcg/dL. The patient was started on oral succimer due to a national shortage of CaNa2EDTA. Five weeks later at delivery the patient had a BLL of 45 micrograms/dL. A BMLC was collected.
**Results:** Case One: BMLC was 4.6 mcg/dL (46 ppb). Case Two: BMLC was 3.5 mcg/dL (35 ppb). Case Three: BMLC was 0.66 mcg/dL (6.6 ppb).
**Conclusion:** The current action level for lead in drinking water is 1.5 micrograms/dL (15 parts per billion). In case the series BLMC did not correlate well with maternal BLL. There is further research that is needed to better determine when BMLCs should be collected and at what maternal BLL breast feeding should be an absolute contraindication.

### 037. Antimuscarinic Toxicity Due to Diphenhydramine Ingestion Treated Successfully with Rivastigmine: A Case Series

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**Background:** The treatment for antimuscarinic toxicity utilizes either antidotal therapy traditionally with physostigmine -a centrally active and reversible cholinesterase inhibitor- or supportive care. However, there has been a shortage of physostigmine since 2019. Rivastigmine, another centrally acting cholinesterase inhibitor, is a potential alternative therapy. However, rivastigmine has limited evidence supporting its use in the management of acute antimuscarinic toxicity.
**Methods:** This is a case series of three diphenhydramine poisoned patients with an antimuscarinic toxidrome who were treated with rivastigmine. Case one: A 17-year-old female presented with bizarre behavior, slurred speech, and paranoia, reporting ingestion of 300-350 mg of diphenhydramine. The patient had urinary retention, dilated pupils, tachycardia to 140 beats per minute, and dry mucous membranes. 1.5 mg of po rivastigmine was given. Case two: A 19-year-old male presented to the emergency department after ingesting approximately 375 mg of diphenhydramine. The patient was agitated, delirious, picking at his clothes, had dilated pupils, urinary retention, and tachycardia to 120 beats per minute. The patient was given 1.5 mg of po rivastigmine. Case three: A 17-year-old male presented to the emergency after ingesting 1200 mg of diphenhydramine, had initial vomiting and an unremarkable exam, but developed tachycardia to 160 beats per minute, confusion, urinary retention, dry mucous membranes, and agitation. The patient was given three mg of po physostigmine.
**Results:** Case one: The patient received 1.5 mg rivastigmine and returned to baseline within one hour post-administration.

Case two: The patient improved after 1.5 mg of rivastigmine but remained altered necessitating a second dose of 1.5 mg of rivastigmine and was then back to baseline. Case three: The patient was back to baseline within 20 minutes, however, two hours later received one mg of lorazepam for agitation.
**Conclusion:** Rivastigmine should be considered in all patients who have antimuscarinic toxicity that can tolerate PO when physostigmine is not available.

### 038. The Use of Rivastigmine in the Treatment of Antimuscarinic Toxidrome after Massive Clozapine Overdose in a Pediatric Patient

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**Background:** Clozapine in overdose can produce an antimuscarinic toxidrome with the exception of sialorrhea due to M4 receptor agonism. Rivastigmine has increasingly been used in treatment of antimuscarinic toxicity due to the nationwide shortage of physostigmine. However, rivastigmine use for clozapine overdose remains unknown.
**Hypothesis:** Rivastigmine could safely treat the antimuscarinic toxidrome of clozapine toxicity.
**Methods:** This is a single case report of a 16-year-old woman who presented after overdose of clozapine, guanfacine, naltrexone, and melatonin. She presented with encephalopathy, tachycardia, and mumbled speech consistent with an antimuscarinic toxidrome. She was treated with both oral and transdermal rivastigmine.
**Results:** The patient's physical exam was notable for agitation, mumbled speech, salivation and sinus tachycardia consistent with clozapine toxicity. Laboratory results included a serum clozapine concentration of 1925 mcg/L (toxic range > 900 mcg/L) and norclozapine concentration of 573 mcg/L (therapeutic range 25-400 mcg/L). Liquid Chromatography/Mass Spectroscopy testing of the urine revealed nicotine, caffeine, naltrexone metabolite, rivastigmine, and clozapine. The patient received two liters of crystalloid and two mg of IV lorazepam. She was administered six mg of oral rivastigmine and had a 13.3 mg/24 hr transdermal patch applied. In the ICU, 24 hours after rivastigmine initiation, her encephalopathy improved, and the patch was discontinued. Approximately 45 minutes after patch removal, she experienced recrudescence of encephalopathy which remitted after replacing the rivastigmine patch. She remained in the ICU for three days before being transferred to the floor where the patch was discontinued on hospital day four with no further requirement of sedatives or rivastigmine.
**Conclusion:** This case suggests that a combination therapy of orally loaded with transdermal maintenance rivastigmine can treat the encephalopathy component of clozapine toxicity with the added benefit of minimal benzodiazepine utilization.

### 039. Antimuscarinic Delirium Reversed by Rivastigmine: a Case Series of 20 Patients

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**Background:** Antimuscarinic toxicity is frequently observed following overdose. Historically, these ingestions could be treated with the centrally acting cholinesterase inhibitor, physostigmine. However, its availability has become limited, and other parenteral cholinesterase inhibitors do not cross the blood brain barrier. Rivastigmine, which is used for dementia and is available as an oral formulation and as a transdermal patch, offers a viable alternative. This case series describes treatment with this new approach.
**Case series:** From June 2021 to November 2022 we treated 20 patients with antimuscarinic toxicity using rivastigmine. Ages ranged from 16 – 63 years old, with a median age of 26.5 years. Thirteen patients were female. Diphenhydramine was ingested in nine cases. In one case diphenhydramine was co-ingested with chlorpromazine. Another time it was co-ingested with quetiapine. Five additional overdoses involved quetiapine. One patient co-ingested benztropine. There were five isolated ingestions: one each involving benztropine, carbamazepine, olanzapine, promethazine, and prochlorperazine. The source of antimuscarinic toxicity was unknown in one encounter. All patients had delirium. The median maximum heart rate was 128 beats per minute. A rivastigmine patch was applied in 19 cases; the 13.3 mg dose was used 17 times and 9.5 mg was administered twice. Oral rivastigmine was administered to 15 patients; 13 patients received six mg, one was treated with 12 mg, and one received a single three mg dose. Thirteen patients required hospitalization. No adverse reactions were noted. Time to symptom resolution ranged from three hours to 12 hours.
**Case Discussion:** Oral and transdermal rivastigmine work more slowly than physostigmine. However, the therapeutic benefits last longer, especially with the transdermal patch. Additionally, the slower absorption minimizes the risk of precipitating seizures that may be seen with rapid physostigmine administration.
**Conclusion:** Rivastigmine is a safe and effective treatment for antimuscarinic toxicity due to a variety of toxicological exposures.

## 040. A Case Report of Contact Dermatitis with Elevated Urinary Arsenic Levels from Acute on Chronic Exposure to Arsenic Trioxide in an Occupational Setting

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**Background:** While the dermal manifestations of chronic exposure to arsenic in drinking water are well-described, there is less information on skin findings in acute and chronic occupational exposure to arsenic.
**Methods:** This is a single-patient case report of acute on chronic exposure to arsenic trioxide. Clinical images were obtained. The patient provided written consent for this report.
**Results:** We evaluated a 53-year-old male with a chief complaint of facial rash after working for approximately three months at a lumber treatment facility. The rash acutely worsened prior to presentation. His duties included directly handling arsenic trioxide to make chromated copper arsenate treated lumber. He presented to an outside hospital with an acutely worsening rash on his face in the context of reported improper usage of personal protective equipment. He was transferred to our institution for evaluation by a burn surgery specialist. The patient had erythematous lichenified plaques on his face, neck, and hands without any evidence of a chemical burn on exam. Dermatology was consulted and their impression was consistent with acute allergic contact dermatitis; they recommended topical steroids. A 24-hour urinary arsenic sample resulted at 669 mcg/L with speciation showing 59 mcg/L of inorganic arsenic and 548 mcg/L of methylated arsenic; 24 mcg/L was attributed as organic arsenic. The patient reported being removed from exposure at his workplace after discharge.
**Conclusion:** This case highlights an example of contact dermatitis due to acute on chronic exposure to arsenic trioxide in an occupational setting with a significantly elevated 24-hour urinary arsenic level that was not attributable to seafood on speciation. In addition to a dermal route of exposure, it is also possible there was oral exposure from improper decontamination before eating and inhalational exposure as the patient described using a respirator for longer than the approved time periods.

## 041. Methotrexate Toxicity: a Report From The ToxIC Registry

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**Background:** The epidemiology and scope of methotrexate toxicity are not well-defined.
**Research Question:** We aim to review all single-agent exposures to methotrexate recorded in the ToxIC registry to report case characteristics, use of antidotal therapy and patient outcomes.
**Methods:** This is a retrospective review of all single-agent exposures to methotrexate reported to the ToxIC registry from 2010 to 2022. Inclusion criteria were single-agent exposure to methotrexate. There were no prespecified exclusion criteria. Data regarding case characteristics, treatments, use of leucovorin antidotal therapy, and patient outcomes are presented descriptively.
**Results:** A total of 72 cases were included in the dataset. The median age was 47 years (IQR: 22-67 years) and 55% were female. Twenty-six percent of cases were related to a medication error including administration and dosing errors, and 15% of cases were related to an attempt at self-harm. With respect to outcomes, 35% of cases had pancytopenia secondary to methotrexate, 18% of patients had acute kidney injury, and five patients (seven percent) died. With respect to therapies, four percent of patients required some form of renal replacement therapy. Additionally on review of free text listed in "other treatment", 44% of cases received leucovorin and four percent received filgrastim/granulocyte colony-stimulating factor. With respect to disposition, seven percent of patients required admission to an intensive care unit. The in-hospital mortality rate was seven percent.
**Conclusion:** Although methotrexate is a relatively uncommon exposure, it is associated with significant morbidity and mortality.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 042. Ingestion of Topical Minoxidil is Associated with Transaminase Elevation in the Absence of Ischemic Hepatitis

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**Background**: Minoxidil is a direct-acting vasodilator that causes smooth muscle relaxation. It has been used to treat refractory hypertension and alopecia. Toxicity is characterized by hypotension and reflex tachycardia, often requiring

alpha-adrenergic agonist therapy. Hypothesis: Ingestion of topical minoxidil can cause transaminase elevation.
**Methods**: This is a retrospective single chart review. A healthy 17-year-old female presented with palpitations three hours after reportedly ingesting 60 mL of Kirkland Signature 5% w/v topical minoxidil solution (diluted in alcohol and propylene glycol). Three liters of intravenous isotonic crystalloid, parenteral *N*-acetylcysteine, phenylephrine infusion, and midodrine were administered.
**Results**: Initial evaluation revealed sinus tachycardia at 117 beats per minute and blood pressure 92/44 mmHg. Laboratory analyses three hours post-ingestion revealed pH 7.4, bicarbonate 17 mmol/L without anion gap, lactate 3.6 mmol/L, INR 0.9, and elevated transaminases (AST 224 IU/L, ALT 384 IU/L). N-acetylcysteine was administered to treat occult acetaminophen toxicity, as transaminase elevation is infrequently reported with oral minoxidil ingestion. Acetaminophen, ethanol, salicylates, and troponin were undetectable. COVID, influenza, RSV, and hepatitis panels were negative. Nadir mean arterial pressure was 57 mmHg seven hours post-ingestion. Phenylephrine was administered; maximum rate was 250 mcg/min 24 hours post-ingestion. Troponin peaked at 0.8 ng/mL 29 hours post-ingestion. She developed pulmonary edema requiring two liters of supplemental oxygen via nasal cannula from 12-68 hours post-ingestion. She recovered completely and was discharged 108 hours post-ingestion. Transaminases normalized despite increasing vasopressor requirements with peak concentrations under 1000 IU/L. This is atypical for ischemic hepatitis. Minoxidil itself may directly affect hepatocytes vs. effect from the alcohol diluent. No signs of toxicity from the propylene glycol diluent were observed.
**Conclusion**: Limitations include retrospective analysis and failure to definitively exclude prior acetaminophen consumption or other viral infection. However, minoxidil may represent an uncommon etiology of transaminase elevation.

### 043. Predictors of Inpatient Mortality in Colchicine Toxicity: an Analysis of the Toxicology Investigators Consortium Registry

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**Background**: Colchicine is an alkaloid derived from *Colchicum autumnale* and *Gloriosa superba* that has been used to treat gout, pericarditis, and autoimmune disorders. Its therapeutic index is narrow. Overdose is often fatal, characterized by gastrointestinal distress, bone marrow failure, and refractory shock. Hypothesis: Inpatient mortality from colchicine toxicity is directly associated with intentional overdose, acute kidney injury (AKI), coagulopathy, and history of coronary artery disease (CAD); it is inversely associated with gastrointestinal decontamination and granulocyte colony-stimulating factor (G-CSF) administration.
**Methods**: This is a retrospective analysis of 47 patients with colchicine toxicity entered in the ToxIC registry (January 2010 - October 2022). Two patients were excluded due to unknown medical history; one was excluded for unknown reason for exposure. Mortality rates with respect to each secondary endpoint were compared using Fisher's exact test. Statistics were performed using IBM SPSS for Macintosh version 29.0. Secondary endpoints comprised intentional vs. unintentional overdose, coingestants, gastrointestinal decontamination, CAD, AKI (creatinine above 2.0 mg/dL), hypotension (systolic blood pressure below 80 mmHg), acidemia (pH less than 7.2), and coagulopathy (prothrombin time greater than 15 seconds).
**Results**: CAD (likelihood ratio LR 7.01, $p = 0.02$), hypotension (LR 8.05, $p = 0.01$), and acidemia (LR 6.27, $p = 0.02$) were associated with inpatient mortality. There was no association with intent of overdose, coingestants, AKI, coagulopathy, or gastrointestinal decontamination ($p$ = NS). Limitations include few patients experiencing the primary endpoint and incomplete data availability. Ingested dose was not uniformly recorded, and G-CSF administration was not included in the registry. Analyzing patient populations treated at ToxIC sites may also introduce selection bias.
**Conclusion**: History of CAD, hypotension, and acidemia may serve as predictors of inpatient mortality from colchicine toxicity. Further research is needed to assess the effects of gastrointestinal decontamination and G-CSF on inpatient mortality secondary to colchicine toxicity.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 044. A Retrospective Analysis of Poison Center Reported Oral Capecitabine Exposure and Use of Uridine Triacetate

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**Background:** Capecitabine (Xeloda®) toxicity is described and the antidote uridine triacetate (UT; Vistoguard®) has been available since 2015. However, little is known about real-world exposures and antidote use.

**Hypothesis:** Unintentional exposures are generally well tolerated.
**Methods:** All capecitabine exposures reported to a single-state Poison Center from April 30, 2001 to December 31, 2021 were reviewed. All single-substance oral exposures were included. Exclusion criteria were iatrogenic overdose, unknown outcome, and incorrect dose timing.
**Results:** 128 cases were identified and 81 were included (58% female). Median age was 63 years (1-92 years); 17 cases (21%) were under 16 years. 49 cases were acute-on-chronic. Of the 32 acute ingestions, 29 were accidental and three intentional. 25 cases (31%) had healthcare facility (HCF) evaluations, 13 of which presented after 2015. Six (46%) received UT: three for gastrointestinal symptoms, one for confusion, and two for asymptomatic post-exposure treatment. UT was administered to two intentional acute ingestions: a 14-year-old female with vomiting after ingesting 15,000 mg and a 19-year-old female without symptoms after ingesting an unknown quantity. No toxicity developed subsequently. The third intentional ingestion, a 16-year-old male, occurred in 2009 before UT was available. He presented asymptomatic after ingesting 7,500 mg but later developed palmar-plantar erythrodyesthesia. Three cases, all initially asymptomatic, had delayed toxicity. One developed vomiting and another palmar-plantar erythrodyesthesia while hospitalized. One had lymphopenia in outpatient follow-up labs. Otherwise, no morbidity or mortality was reported.
**Discussion:** Accidental exposures and extra doses managed in HCFs were uncommon and few developed more than minor symptoms. Those managed at home were instructed to call back if symptoms developed and none did. Of note, 46% of HCF managed patients presenting after 2015 received UT. Further research is needed to define toxicity thresholds and clear indications for UT use.

## 045. "That's not Cough Syrup": Pediatric Siblings Accidentally Poisoned by the Organophosphate Pesticide Coumaphos

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**Background:** Pediatric organophosphate insecticide poisonings are rare in the United States and life-threatening toxicity is unusual. We report two accidental ingestions of the organophosphate insecticide coumaphos that resulted in life threatening symptoms.
**Methods:** This was a two-patient retrospective chart review. Consent was obtained from the patients' mother. A seven year-old male and 10 year-old female both presented from home after accidental ingestion of one "spoonful" of coumaphos 20% liquid (Asuntol®; Bayer de Mexico, S.A. de C.V., Mexico D.F., Mexico). There were no other known ingestions. Both became rapidly symptomatic, with the male developing dyspnea, vomiting, and depressed mental status and the female developing headache and nausea. Soon after, the male had a witnessed cardiopulmonary arrest and the female developed altered mental status and flaccid paralysis.
**Results:** Both patients were treated initially with atropine in the emergency department but required no additional doses. On arrival to the pediatric intensive care unit, both received pralidoxime with subsequent plasma exchange, and continuous venovenous hemodiafiltration. Transient anemia, coagulopathy, transaminitis, and hyperglycemia developed in both patients. The female was extubated on hospital day six and the male on hospital day 11. The female's course was complicated by aspiration pneumonia and an isolated seizure. The male's course was complicated mainly by anoxic brain injury, with associated seizures, neuroagitation, spasticity, and autonomic instability. The female was discharged on hospital day 16 and remained asymptomatic 32 days after ingestion. As of 90 days after ingestion, the male remained admitted to inpatient rehabilitation.
**Conclusion:** The optimal treatment regimen for organophosphate insecticide toxicity remains poorly defined. The clinical benefit of pralidoxime, plasma exchange, and CVVHDF is uncertain in these cases.

## 046. Human Bromethalin Ingestions and Outcomes Reported to a Single Poison Center, 2013 to 2022

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**Background:** Bromethalin is a commercial rodenticide that has largely supplanted use of long-acting anticoagulant rodenticides. Despite a toxic mechanism involving uncoupling of oxidative phosphorylation, few case reports describe severe outcomes following human ingestion, with unintentional or exploratory ingestions often remaining

asymptomatic. We characterized human bromethalin exposures reported to a single poison center.
**Hypothesis:** Exploratory bromethalin ingestions have low likelihood of severe toxicity.
**Methods:** This is a retrospective cross-sectional review of human bromethalin ingestions reported from August 2013 to August 2022. Data included demographics, amount ingested, intentionality, clinical symptoms, therapeutic interventions, and medical outcomes as defined by the NPDS. Other routes of exposure were excluded.
**Results:** Two hundred eighty-three bromethalin ingestions were reported to our center in the study timeframe. The majority ($n = 253$) were unintentional ingestions. Average patient age was nine years. The majority of ingestions were unintentional or exploratory pediatric exposures. Of 253 unintentional ingestions, one (0.40%) subject had a major outcome and one (0.40%) died. The average age of this cohort was 5.6 years. Nine subjects (3.6%) had minor effects; the rest remained asymptomatic. Notably, the child that died was admitted overnight after bromethalin ingestion with an uneventful stay; two months later he returned in cardiac arrest. Outcomes were more severe in intentional ingestions. Average age of this group was 43. Among 18 intentional ingestions, five (28%) had major outcomes and one died. The patient that died had a questionable history of exposure.
**Discussion:** This study characterizes a large sample of human bromethalin ingestions reported to a state poison center. Intentional bromethalin ingestions are associated with risk of significant toxicity However, most unintentional ingestions, especially pediatric cases, are unlikely to have severe outcomes. This data can help inform appropriate triage and patient management decisions secondary to bromethalin ingestions.

## 047. Massive Metformin Overdose with Metformin-Associated Lactic Acidosis: an Unexpected Case of a Lactate Gap

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**Background:** In cases of metformin associated lactic acidosis (MALA), lactate is utilized as a marker of toxicity. We report a case of an acute, severe metformin toxicity resulting in discrepancy between lactate measurements utilizing three different instruments for measurement.
**Methods:** This is a case report via chart review of a 34-year-old female with history of type 2 diabetes presenting after reported overdose of metformin, venlafaxine, risperidone, ibuprofen, clindamycin, trimethoprim-sulfamethoxazole and hydroxyzine.
**Results:** The patient presented to an outlying hospital and was transferred to tertiary care center, requiring intubation and three vasopressors for refractory hypotension. Metformin level was 150 mcg/mL (therapeutic 1-2 mcg/mL). A lactate variation was first noted between the i-Stat and the Beckman-Coulter analyzer, however it persisted within the same instrument (ABL radiometer) over several draws. Lactate levels drawn approximately every hour over 8 hours showed the following trend in mMol/L (with corresponding instrument): (i-stat): >20.0, (Beckman-Coulter):14.8, (ABL radiometer): 29.0, 15.0, 27.0, 13.7, 24.0, 20.0, 14.4 before consistently trending down. The trend in pH over the corresponding time frame was: 6.82, <6.79, 7.17, 7.24, 7.28, 7.33, 7.41. Ethylene glycol and methanol levels were obtained which were undetectable. The patient underwent 16 hours of emergent hemodialysis. She was weaned off all vasopressors by day 3 of admission, neurologically intact and ultimately transitioned to psychiatric care.
**Conclusion:** We present a case of metformin toxicity with a "lactate gap" resembling ethylene glycol toxicity (although in ethylene glycol poisoning, typically over-estimation occurs from misidentification of glycolate as lactate in certain assays). As a marker of overdose severity, underestimation of lactate could alter management of metformin toxicity. Clinical status, pH and lactate should be considered in aggregate in decisions regarding treatment of severe metformin toxicity.

## 048. Pediatric Metformin Exposures Reported to NPDS

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**Background:** Metformin is a commonly prescribed diabetes mellitus medication, leading to increased risk of pediatric exposures.
**Objective:** To determine clinical course, outcomes, and milligram/kilogram (mg/kg) dose of metformin ingestion in children under six years old reported to America's Poison Centers (APC) recorded in the National Poison Data System (NPDS).
**Methods:** This NPDS chart review (2011-2020) searched for single-agent metformin ingestion cases in patients under six years old. Variables included patient age/sex, weight, dose ingested, clinical findings, medical outcome, treatments, reason for ingestion, and place of treatment.
**Results:** Of 8917 cases, 3959 (44.4%) were female. Patient age distribution was 490 (5.5%) under one year, 2952 (33.1%) 12-23 months, 3718 (41.7%) two years, 1186 (13.3%) three years, and 562 (6.3%) four-five years old. Of cases, 6625 (74.3%) were managed on site (non-HCF), 1703 (19.1%) were at/enroute to a HCF, and 464 (5.2%) were referred to a HCF. Medical outcomes were 3790 (42.5%) not followed-minimal clinical effects, 3237 (36.3%) no effect, 187 (2.1%) minor effect, 80 (0.9%) moderate effect, 9 (0.1%) major effect, 0 deaths, 68 (0.5%) not followed-judged nontoxic, and 232 (2.6%) unable to follow-potentially toxic. The most frequently reported clinical effects were vomiting (132, 1.5%), hypoglycemia (54, 0.61%), acidosis (54, 0.61%), diarrhea (46, 0.52%), and drowsiness/lethargy (39, 0.44%). Serious effects included seizures (4, 0.04%), coma (2, 0.02%), renal failure (1, 0.01%). Amount ingested was available for 2311 (25.9%) showing a median 500 mg, SD 20,823.5. Mg/kg data were available for 1300 (14.9%), with median 40.8 mg, SD 2443.1. Of 2171 patients in a HCF, 1700 (78.3%) were released, 145 (6.7%) admitted to noncritical unit, and 76 (3.5%) admitted to a critical care unit.
**Conclusion:** Metformin ingestion was generally safe in children under six. Poison center documentation of weight and ingested dose were often unavailable.

## 049. Is There a Safe Threshold for Pediatric Ingestion of Metformin?

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**Background:** Metformin is a commonly prescribed medication for diabetes mellitus, increasing the risk of pediatric exposures. Texas Poison Center Network (TPCN) uses a threshold of 85 milligram/kilogram (mg/kg) or higher to refer to a healthcare facility (HCF)
**Objective:** To describe outcomes of metformin ingestion in children under age six reported to America's Poison Centers (APC) recorded in the National Poison Data System (NPDS). These ingestions were divided into safe (< 85 mg/kg) and caution (≥ 85 mg/kg) ranges.
**Methods:** This chart review of NPDS (2011-2020) searched for single-agent metformin ingestion cases in patients under age six. Variables collected included patient age/sex, weight, dose ingested, clinical findings, medical outcome, treatments, reason for ingestion, and place of treatment.
**Results:** Of 8917 cases, 1300 cases had patient weight and dose. Median mg/kg ingestion was 40.8 mg, SD 2443. Of minor clinical effect exposures, 83.9% were safe range. Of moderate clinical effect exposures, 87.5% were caution range. Of exposures managed on site, 89% were safe range versus 57% caution range. Of exposures enroute to HCF when TPCN called, 26.7% were caution range and 13.7% were safe range. Of exposure referred to HCF, 15.2% were caution range and 2.4% were safe range. Of patients treated/evaluated and released, 73.7% were in the safe range. Of patients admitted to non-critical care, 9.6% were in the caution range and 2.8% were in the safe range. Of patients admitted to critical care, 4.8% were caution range and 1.1% were safe range. Critical care admissions accounted for 75 (5.7%) exposures. The most frequent clinical effects were hypoglycemia (18, 24%), acidosis (17, 22.6%), vomiting (10, 13.3%), and drowsiness/lethargy (10, 13.3%). Serious effects included seizures (1, 1.3%), coma (2, 2.6%), renal failure (1, 1.3%).
**Conclusion:** A 85 mg/kg threshold can capture clinically significant metformin ingestion while reducing unneeded healthcare utilization.

## 050. Intravenous Dettol® Injection Resulting in Compartment Syndrome and Phlegmasia Cerulea Dolens

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**Background:** IV Dettol exposures are rare and infrequently reported. We report a life-threatening IV Dettol injection.
**Case:** A 43-year-old female presented with dizziness and left hand swelling after injecting Dettol (chloroxylenol (4.85%), pine oil, isopropyl alcohol, castor oil, caramel) into her left wrist and ingesting diclofenac 75mg x 100 tabs. Her GCS was 14, vital signs and physical exam normal except for a swollen and firm left hand. Capillary refill of her left fingers was < 2 seconds. Lab testing revealed normal VBG, AST 134 IU/L, creatinine 132 umol/L, urea 7.9 mmol/L, CK 862 IU/L and high sensitivity troponin 1036 ng/L. Her chest radiograph was normal and XR her left forearm showed subcutaneous air. Doppler ultrasound demonstrated pulsatile arterial blood flow and DVT in her right upper limb vein. The hand became dusky and cool with delayed capillary refill, and surgeons performed fasciotomy. During fasciotomy she twice developed asystolic cardiac arrest with resuscitation and ROSC. Her post-arrest echocardiogram showed EF 60%, mild right ventricle dilatation, and SVC/right atrium thrombus. CTPA showed diffuse bilateral segmental and subsegmental pulmonary emboli. She developed anuria treated by dialysis and received heparin for the pulmonary embolism. She was mechanically ventilated for respiratory failure on days 19-25. The left hand was treated by debridement twice then skin graft. She was discharged on day 63 with normal renal and pulmonary functions.
**Conclusions:** This IV Dettol and diclofenac exposure caused extremity injury with compartment syndrome, phlegmasia cerulea dolens, pulmonary embolism, cardiac arrest and renal failure. The hand injury appeared to be a direct result of the injection, but besides elevated troponin, she had no systemic issues prior to her cardiac arrests. The diclofenac likely played a significant role in toxicity, especially acute kidney injury. IV Dettol exposure is limb threatening and potentially lethal.

## 051. Ruling Out Severe Carbon Monoxide Exposure Without Carboxyhemoglobin Levels: a Symptom-driven Approach

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**Background:** Carbon Monoxide (CO) represents a common exposure evaluated by toxicologists and poison control centers. Current guidelines rely on carboxyhemoglobin levels to distinguish exposure severity and guide treatment. Based on testing availability this can significantly lengthen the time to medically clear mild CO exposures and create therapeutic dilemmas.
**Research Question:** Can severe CO exposures be ruled out without a carboxyhemoglobin level using a purely symptom driven approach?
**Methods:** This is a retrospective analysis of patients from Northwell-affiliated hospitals from November 1st 2019 through November 1st 2021 diagnosed with CO exposure from Emergency Departments. Exclusion criteria include: pregnancy, age <18, alternative cause of altered mental status or history of dementia or migraines. Cases with recorded CO levels were retrospectively evaluated for demographic data (age, gender, disposition) and key symptoms (headache, nausea, dizziness, fatigue), carboxyhemoglobin level, and triage vital signs. High-risk classifications were chosen from common criteria for hyperbaric intervention (carboxyhemoglobin level >25, syncope, altered mental status, cardiac ischemia, or cardiac arrest) with low-risk defined as no positive symptoms.
**Results:** Three-hundred and seventy patients were identified of which 283 met inclusion-criteria. Severe exposure represented 14.5% (41/283) of cases with no significant differences in gender (39.0% vs. 56.2%, $p$ = NS) or age (45 $\pm$ 18 vs. 43 $\pm$ 18, $p$ = NS) in the severe- vs. mild-cases. Symptom-driven assessment of CO severity carried a sensitivity of 97.8% (95% CI: 92.3-99.7%) with a specificity of 20.3% (95% CI: 14.9-26.7%) for ruling out severe exposures. Bootstrap analysis of variables demonstrated dizziness ($p = 0.006$), heart rate ( $p = 0.004$), and diastolic blood pressure ($p = 0.003$) were most associated with severity categorization.
**Conclusion:** Patients who report no symptoms of CO toxicity carry a low rate of "severe" classification. Screening patients using a symptom- and vital sign-driven algorithm may allow for medical clearance of low-risk exposures without requiring carboxyhemoglobin levels.

## 052. Management of Methemoglobinemia in a Resource Limited Setting: a Simple Bedside Test

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**Background:** Methemoglobin (MetHb) levels are primarily used to diagnose and guide treatment of methemoglobinemia, but in several countries the instrumentation needed to perform accurate quantitative analysis is not readily available.
**Methods:** We report a case from Pakistan of a 53-year-old female being treated with primaquine for falciparum malaria. She presented with shortness of breath and exhaustion. Her vital signs were: Oxygen 85% on RA; RR 24/min; HR 95 bpm; BP 115/86 mmHg. Physical exam demonstrated central cyanosis and lungs that were clear to auscultation. Vitals did not improve with supplemental oxygen. Lab draw revealed chocolate-colored blood. MetHb measurement was delayed by the hospital laboratory due to a machine error. Therefore, the MetHb level was estimated with a color chart, referenced from the literature. After allowing the patient's blood to dry on white paper and comparing it to a reference color chart, the MetHb level was estimated to be 30%. She received a single dose of methylene blue, one mg/kg, with resolution of cyanosis and dyspnea. The MetHb level eventually resulted from the lab 24 hrs later at 36%.
**Results:** MetHb levels greater than 15% can be detected visually with a color chart. This simple, low-cost, and convenient bedside test can assist in the rapid estimation of a significant MetHb level. This technique can encourage the expeditious use of methylene blue, as well as discourage an aggressive workup of alternative etiologies &/or the use of alternative treatments such as exchange transfusion therapy.
**Conclusion:** The MetHb color chart can be used to expeditiously diagnose clinically significant MetHb, and is of particular value in a resource-poor setting that lacks the instrumentation needed to perform an accurate quantitative analysis.

### 053. Firework Ingestions Reported to US Poison Centers

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**Background:** Firework ingestions have potential to cause serious toxicity. Components including oxidizers and metals can possibly result in hemolysis, methemoglobinemia, or hypokalemia. Firework ingredients are regulated in the United States (US) in an effort to mitigate toxicity.
**Research Question:** What are the characteristics of firework ingestions reported to US Poison Centers (PCs)?
**Methods:** We conducted a retrospective review between January 1, 2015 and October 31, 2022 of the National Poison Data System (NPDS). We descriptively assessed the demographic and clinical characteristics related to single substance firework ingestions.
**Results:** A total of 5665 single substance firework ingestions were reported to US PCs during the study period. The vast majority were unintentional exposures (5549, 98.0%). Pediatrics (defined as age ≤19) accounted for a majority of ingestions (4920, 86.8%). The largest age groups were age one year (1463, 25.8% of total cases) and age two years (1427, 25.2% of total cases). Most cases (4914, 83.0%) had no symptoms. When symptoms were reported, the most common were vomiting (298, 5.0%), oral irritation (92, 1.6%), cough (80, 1.4%), and abdominal pain (73, 1.2%). Electrolyte abnormalities were rare (10, 0.17%). There were no reported cases of hemolysis or methemoglobinemia. Residence was the most common site of exposure (5000, 88.3%) and most cases (5111, 90.2%) were managed outside of the hospital. Most were treated with dilution/irrigation/washing (4181, 73.8%), no treatment (1222, 21.6%), or food/snack (1185, 20.9%). There was one death during the study period. Most exposures occurred during July (2526, 44.6%), followed by June (649, 11.5%), January (341, 6.1%), and December (238, 4.2%).
**Conclusions:** Firework ingestions reported to PCs between 2015 and 2022 resulted in largely benign outcomes that did not require treatment in a healthcare facility. Pediatrics constituted the majority of ingestions which occurred in months surrounding July fourth and the New Year.

### 054. Evaluation of the Role of Dexmedetomidine in Critically Ill Serotonin Syndrome Patients: a Case Review

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**Background:** Serotonin toxicity is a potentially life-threatening emergency due to increased serotonin potentiation in the brain. The treatment is benzodiazepines and supportive care, including mechanical ventilation and cooling measures. Dexmedetomidine is an alpha-2 agonist that is a potential adjunct therapy.
**Hypothesis:** Dexmedetomidine used as an adjunct to benzodiazepines may decrease mechanical ventilation time, peak creatine kinase (CK), maximum temperature, or length of intensive care unit (ICU) stay in patients with serotonin toxicity.
**Methods:** A single-center, retrospective cohort study identified 126 emergency room visits with serotonin toxicity-related ICD-10 codes over a six-year period. These patient encounters were screened for positive Hunter Criteria (32 patients). 9 patients were admitted to the ICU on ventilatory support; 6 patients received benzodiazepines and 3 patients

received benzodiazepines and dexmedetomidine. Study variables were extracted from medical charts: maximum temperature, maximum CK, length of ventilation, and ICU stay.
**Results:** Patients treated with dexmedetomidine had higher average ventilation times (76.5 hours vs 18.6 hours), ICU stays (5.7 days vs 2 days), CK values (1435 U/L vs 670 U/L), and maximum temperatures (39.5 C vs 38.5C) compared to the control group. Values ranged in both groups from ventilation times of 28.5 -114 hours in the dexmedetomidine group and 1.5 -41 hours in the control; ICU stay of 3 -8 days in the treatment group and 1 -3 days in the control; CK values of 102 U/L -3962 U/L in the treatment group and 63 U/L -1141 U/L in the control; and max temperatures of 38.2C -41.8C in the treatment group and 37.2C -39.3C in the control.
**Conclusions:** It was observed that dexmedetomidine was used in more severe cases of serotonin toxicity, indicating a potential need for adjuvant treatment. More research is still needed to determine if dexmedetomidine should become a mainstay of treatment.

### 055. Low Molecular Weight Polyethylene Glycol is Never Used for Decontaminating Dermal Phenol Exposures: a Poison Center Observational Study

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**Background:** Phenol is used in OTC products, disinfectants and in the laboratory. Dermal exposure may result in chemical burns, systemic toxicity, and fatal effects in minutes to hours. Because of the severity of toxicity, rapid and effective dermal decontamination is important. Animal studies have shown conflicting results, but low molecular weight polyethylene glycol (LMW-PEG) and 70% isopropanol may be superior to water. Hypothesis: Dermal exposures to phenol are unlikely to receive LMW-PEG for decontamination.
**Methods:** This is a retrospective study of a single poison center from 2002–2022. A Toxicall search of human exposure to phenol using generic AAPCC code 0040260 and verbatim. Cases were excluded if the phenol exposure was an antiseptic or not a dermal exposure. The primary outcome was which decontamination agents were used.
**Results:** There were 41 cases, 25 were excluded and 16 analyzed. The median age was 29 years old (SD 10.3) and 75% male. Occupational exposure accounted for 16/16 (100%) of cases. Symptoms were present in 13/16 (81%) cases, which included: pain (77%), redness (69%), and blisters (23%). Dermal decontamination was performed in 13/16 (81%), utilizing LMW-PEG in 0/13 (0%), water 6/13 (46%), HMW-PEG 1/13 (8%), both water and HMW-PEG 5/13 (38%), water and isopropanol 1/13 (8%) of cases. Despite no reported use of LMW-PEG for decontamination there was no evidence of worsening or systemic effects after water decontamination. Two patients were observed in the hospital overnight and no deaths were recorded.
**Conclusion:** Although LMW-PEG and isopropanol are often recommended for decontamination of a dermal phenol exposure, they were never used in our study. Our data demonstrates the real-world use of decontamination agents for phenol exposure and likely reflect the lack of access to LMW-PEG. This study is limited by its small sample size and retrospective design at a single poison center.

### 056. Hydrogen Sulfide Toxicity with Delayed Coronary Artery Vasospasm Induced Cardiac Injury

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**Background**: Hydrogen sulfide (H2S) is a colorless gas produced in various industrial and agricultural settings and is considered a "knockdown agent" for its ability to cause a rapid loss of consciousness at high concentrations. Cardiac injury has been described in survivor cases without documented physiology.
**Hypothesis**: Victims of H2S toxicity develop delayed vasospastic cardiac injury two to four days following exposure.
**Methods**: This is a single patient case report. A 35-year-old man was found unconscious for an unknown period in a tanker he was cleaning using nearby creek water with significant farm runoff. The tanker transported and pumped ammonium lignosulfonate into a storage container on the property. Information regarding the incident was obtained from the on-scene emergency providers who used a photoionization detector to measure H2S levels. The patient's presentation and work-up done as routine clinical care was collected from the medical chart during and after hospitalization.
**Results**: On arrival at the emergency department, the patient demonstrated rhonchorous breathing with an initial echocardiography (ECG) showing sinus tachycardia and ST elevation in V1-V2, I, and II without reciprocal change. Responders at the scene found only H2S at a level of 34.1 ppm (parts per million) in the tanker one hour following extrication. On hospital day 2 troponin concentrations collected three hours apart were 661 and 1000 ng/L, respectively. A repeat ECG revealed worsening ST elevation in V1-V2, I, and II and new ST elevation in leads aVL, V5-V6 with ST depressions in III and aVR. A transthoracic echocardiogram revealed a left

ventricular ejection fraction of 46% with global dysfunction. The patient underwent emergent coronary catheterization which revealed normal coronary arteries with large vessel vasospasm and global hypokinesis.
**Discussion**: This case highlights an example of delayed cardiac injury with documented coronary vasospasm on catheterization following H2S exposure.

### 057. A Case of Fatal Ingestion of Phosphoric Acid and Zinc Nitrate

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**Background:** Phosphoric acid has a variety of industrial applications and is widely available as a corrosion inhibitor, but few case reports exist describing its toxicity.
**Hypothesis:** Ingestion of phosphoric acid can cause cardiopulmonary failure resulting from acute metabolic acidosis with hypocalcemia.
**Methods:** This is a single patient clinical and autopsy case report. A man in his 40s who worked at a corrosion protection agency was found seated on a warehouse floor stating that he had intentionally ingested approximately 300mL of a mixture of phosphoric acid and zinc nitrate.
**Results:** In the emergency department, he complained of diffuse abdominal pain and was found to have yellow discoloration of the tongue. Initial vital signs showed blood pressure 170/80 mmHg; pulse 97/min; respiratory rate 25/min; SpO2 98%; and temperature 98.4° F (36.9° C). He was subsequently intubated due to pooling of secretions in the oropharynx and worsening delirium. Laboratory testing revealed severe metabolic acidosis (pH 6.76; HCO3- 1.7 mmol/L), hypokalemia (2.9 mmol/L), hyperphosphatemia (7.4 mg/dL), and a low ionized calcium (0.93 mmol/L). EKG showed sinus tachycardia with normal intervals. Computed tomography showed a distended stomach with hyperdense contents, diffuse esophagitis, gastritis, and enterocolitis without evidence of perforation. Despite administration of intravenous calcium and sodium bicarbonate, the acidemia did not improve. The patient progressed to a state of shock and was pronounced dead four hours later. Autopsy revealed caustic changes to the gastrointestinal tract, upper airway, lung, liver, pancreas, spleen, and periaortic soft tissues. Microscopic analysis of the gastrointestinal tract demonstrated loss of the mucosal layer with coagulative necrosis.
**Conclusion:** Ingestion of phosphoric acid and zinc nitrate not only caused local caustic injury and coagulative necrosis, but also systemic effects including severe metabolic acidosis, hypocalcemia, and death.

### 058. Trends in Pregnancy and Overdose Reported to the Toxicology Investigators Consortium (ToxIC) Core Registry 2014-2021

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**Background:** According to the annual report of the American Association of Poison Control Centers' National Poison Data System, 18.2% out of the 6,199 exposures during pregnancy were intentional in 2020.
**Research Question:** What are the characteristics of acute intentional exposures during pregnancy that were reported to the Toxicology Investigators Consortium (ToxIC) Core Registry between January 2014 – December 2021?
**Methods:** This is a prospective analysis of all intentional overdoses in pregnant women identified from the ToxIC database from 2014-2021. We considered cases to be intentional if the patient expressed self-harm or suicidality. Each case was reviewed for age, exposure type, number of exposures, clinical signs and symptoms, and treatment. Age was further categorized into four groups: 10-19, 20-29, 30-39, and 40-49 years. Exclusions included age over fifty years and any false positive pregnancy tests. Categorical variables were compared using chi square tests.
**Results:** Of the 13,316 cases of intentional exposures in women, 123 cases included pregnant patients. In total, over-the-counter analgesics were the most common class of ingestion (28.1%), followed by antidepressants (15.1%), and sedative-hypnotics/muscle relaxants (11.4%). The majority of pregnant patients were ages 20-29 (72.1%). More than a third of patients ingested more than one class of medication or agent. Patients aged 10-19 years were more likely to ingest five or more medications ($p = 0.03$). About two-thirds of the patients developed signs and symptoms of toxicity, with the majority developing CNS depression, followed by agitation, and tachycardia (heart rate >140 bpm). N-acetylcysteine was the most common antidote administered.
**Conclusion:** The majority of intentional drug exposure in pregnant women included non-opioid analgesics and sedative-hypnotics/muscle relaxants in women less than 29 years. Further studies should investigate the risks of fetal harm and outcomes in intentional overdoses during pregnancy.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 059. Emergent Cesarean Section from Clonidine Toxicity

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**Background:** Clonidine is a central alpha-2 and imidazoline receptor agonist. It is used for treatment of hypertension, ADHD, and as an adjunct in certain withdrawal syndromes. Effects in overdose include hypotension and bradycardia. Clonidine is a pregnancy category C medication: no well-controlled studies have been conducted and its use in pregnant women is only recommended if clearly needed. It is known to cross the placenta; however, little is known regarding its fetal effects.
**Methods:** This is a single patient chart review.
**Results:** A 25-year-old 33-week pregnant female presented after ingesting at least ten 0.1 mg clonidine pills. Her vitals were significant for bradycardia (heart rate 40 bpm). Her blood pressure was initially 136/84 mmHg but dropped to 109/76 mmHg. On exam, the patient appeared lethargic. Fetal heart rate monitoring showed late decelerations with heart rate repeatedly dropping below 110 bpm, so the patient was taken for cesarean section. Upon delivery, the baby's vitals were within normal limits and required neonatal resuscitation including warming, stimulation, and airway clearance; however, was not bradycardic. The mother had persistent bradycardia and hypotension with systolic blood pressure of 80 mmHg that improved with supportive care. She was medically cleared on her third day of hospitalization.
**Conclusion:** Clonidine overdose can lead to hypertension followed by hypotension and bradycardia and can mimic opioid overdose. Because clonidine crosses the placenta, it was suspected that direct action of clonidine on the fetus in addition to hemodynamic effects in the mother led to fetal distress that necessitated the emergency cesarean section. We are not aware of any prior reports of clonidine overdose causing fetal distress in the literature. Previous animal studies have shown some effects on maternal-fetal physiology, including decreases in uterine blood flow, as well as decreases in fetal blood pressure and heart rate.

### 060. Anagrelide Overdose with Hypotension and Severe Orthostasis: First Reported Case

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**Background:** Anagrelide is an imidazoquinoline anti-megakaryocytic used to treat thrombocytosis. It inhibits phosphodiesterase III (PDEIII) and can cause dose-dependent vasodilation. Although anagrelide has been used since 1998, there are no published reports of intentional overdose.
**Hypothesis:** As a PDEIII inhibitor with a prolonged elimination half-life, tachycardia, hypotension, and orthostasis after a large anagrelide overdose is expected.
**Methods:** Single patient case report.
**Results:** A 74-year-old woman with a history of essential thrombocythemia and major depression disorder ingested 54 anagrelide 0.5 mg, three clonazepam 0.5 mg and three citalopram 40 mg in a suicide attempt. 911 was called after she fell several times. In the Emergency Department, she was hypotensive (78/32 mmHg) and tachycardic (115), which initially responded to two liters IV fluid. Initial exam was remarkable for somnolence, midrange and reactive pupils, and periorbital ecchymosis and epistaxis. Neurological exam revealed normal tone and command-following. CT scans of the head through the pelvis did not reveal any major injuries. ECG demonstrated sinus tachycardia, a PR of 149, a QRS duration of 95, and a QTc of 530. Lab work showed a platelet count of 555, anion gap of 9, bicarbonate of 29, and undetectable acetaminophen, salicylate, and ethanol levels. On Venous Blood Gas (VBG) analysis, pH was 7.38 and her lactate was 2.1. She was admitted to the ICU, where norepinephrine was initiated and titrated to maintain mean arterial pressure above 65 mmHg (peak dose seven mcg/min). After 16 hours of pressor therapy, her blood pressure improved, and she was transferred to the floor on post-ingestion day one. She had persistent tachycardia (up to the 120s) and postural orthostasis for three days post-ingestion. She was transferred to inpatient psychiatry after resolution of symptoms.
**Conclusions:** Anagrelide, a PDEIII inhibitor, can result in hypotension, tachycardia, prolonged QTc, and persistent orthostasis in overdose.

## 061. The Impact of COVID-19 on Poisonings in Youth in Georgia

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**Background:** The COVID-19 pandemic has caused an unprecedented youth mental health crisis. Examining poisoning-related morbidity and mortality changes is vital to understand gender differences in response to the pandemic.
**Research Question:** What is the difference in the number of male and female adolescents with suspected suicide attempts by poisoning reported to the Georgia Poison Center (GPC) before and during the COVID-19 pandemic?
**Methods:** This is a retrospective chart review of calls documented in the GPC electronic medical record system, ToxSentry, comprising all poisoning calls for the State of Georgia. Suicidal ingestion calls from March 1, 2012; to March 1, 2022; for adolescents aged 13-19 years were included. Daily calls meeting inclusion criteria before and after the WHO declaration of the COVID-19 pandemic on 3/11/20 were evaluated using an interrupted times series approach. Daily calls were modeled using a negative binomial regression with Newey-West standard errors, determining whether the slope for time changed during the pandemic. Separate regressions were estimated for the full sample, male patients, and female patients.
**Results:** There were 25,738 calls (19,711 females, 6,027 males) meeting inclusion criteria. Before the pandemic, the number of suspected suicide calls increased over time (RR = 1.09, 95% CI: 1.08–1.11). During the pandemic, the number of suspected suicide calls significantly increased ($p < 0.01$) (RR = 1.22, 95% CI: 1.14–1.30). When stratified by gender, a significant increase in slope was observed for females ($p < 0.01$) but not for male patients ($p = 0.84$).
**Conclusion:** In this study, gender was a significant risk factor for adolescent suicidal ingestions during the pandemic. We observed a disproportionately increasing incidence of suspected suicide calls from females compared to males. Practitioners need to account for gender in education and treatment to address youth mental health impacts.

## 062. Evaluating a Poison Center Based Safe-Storage Program

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**Background:** Pediatric poisonings cause 75,000 emergency department visits and 540,000 poison centers calls annually. Improper storage is the most common cause of pediatric medication poisonings, with only 25% of caregivers safely storing medications.
**Hypothesis:** A poison center storage program will increase the number of caregivers storing medications in a locked space.
**Methods:** We conducted a prospective cohort study of adults with at least one child less than 6 years old living in or visiting their residence at least once weekly. People not meeting inclusion criteria, that already had a lockbox, or were less than 18 years old were excluded. Participants were notified using social media, press releases, or referrals from poison specialists and enrolled using our website. We collected demographic information, and medication storage practices and perceptions. A one-month follow-up evaluated storage behaviors.
**Results:** Participants ($n = 124$) were 82.3% female with a median age of 37 years, and 8.9% had previously contacted the poison center. Most participants (72.6%) indicated they would store medications in a locked space if available, but only 16.9% indicated they would purchase a lockbox. Most participants strongly agreed that a lockbox prevents pediatric poisonings (86.3%) and that a small amount of a medication can cause significant harm (86.3%). Our follow-up survey (response rate = 54%) showed that 70.1% used the lockbox and most of these respondents (70.2%) used it for more than 21-days. A majority thought it was easy to use (82.1%), and the most common difficulties were related to the box size, issues reading or remembering the combination, or forgetting medications.
**Conclusion:** These results suggest that our program increased access to lockboxes and most respondents used the device during the study period. Additional research is needed to evaluate the persistence of changed storage behaviors and the impact of lockboxes on pediatric poisonings.

## 063. The Art of Medical Phone Consults From A Poisons Information Centre

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**Background:** Medical toxicologists perform consults over the phone and give recommendations to physicians without the benefit of bedside evaluations. It is important for the toxicology consultant to be able to give clear and concise advice but there is a lack of research looking at how this can best be done.
**Hypothesis/research question:** Do medical toxicologists provide specific recommendations to callers during phone consults and are recommendations consistent between providers?
**Methods:** This was a retrospective review of recorded calls regarding snake bites made to the New South Wales Poison Information Centre (PIC) located in Sydney, Australia over 15 months. Snake bite cases were chosen for review because care is standardized, and focus could be placed on how toxicologists were communicating with callers. Fifty seven cases where a toxicologist spoke directly to a calling provider on the phone were included and reviewed by a single reviewer to determine if specific advice regarding management and antivenom use were given.
**Results:** Advice by the consultant was nonspecific in 49% of cases, specific in 37% of cases, and in 3.51% cases the caller was referred to the publicly available Therapeutic Guidelines (ETG). Recommendations made by consultants were consistent with the ETG in 82.46% of cases. Complications of envenomation were discussed in 70.17% of cases and pressure bandage immobilization management was discussed in 77% of cases. In 45.61% of cases, the consultant did not specifically tell the caller to call back. In 54.4% of cases, callers were encouraged to call back with questions or changes in patient condition.
**Conclusions:** While most toxicologists made recommendations consistent with national guidelines, there was inconsistency in asking for call backs and in providing specific advice for management of snake bite patients. Closed loop communication may be a useful tool to use in the future to improve communication between consultant and caller.

### 064. Analysis of Skeletal Muscle Relaxant Poisonings in Pediatric and Adolescent Patients as Reported to the National Poison Data System, 2010-2020

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**Background:** Skeletal muscle relaxants (SMRs) are commonly prescribed and result in many poisoning exposures in the United States. However, the demographics, scenarios, clinical effects, and outcomes associated with these exposures are not adequately defined by scientific literature relating to pediatric and adolescent populations.

**Methods:** The National Poison Data System (NPDS) was utilized to conduct a retrospective review of de-identified data from cases involving single-agent exposures to carisoprodol, meprobamate, methocarbamol, or metaxalone for patients between ages 6-19 between January 1, 2010, and December 31, 2020. Cases with multiple co-ingested substances were excluded to determine the true clinical effects following exposures to the SMRs of interest. Variables and outcomes of interest included year of exposure, age and biological sex of patient, reason and route of exposure, chronicity of exposure, management site, symptoms observed following exposure, medical outcome, and commonly utilized interventions. Data were summarized utilizing descriptive statistical methods.
**Results:** 2605 cases were included in the retrospective review. The average age of individuals was 15.47 (+/- 3.19) years, and 42.19% were male. Incidence of cases declined between 2010 and 2020. 75.74% of reported cases involved intentional exposures, with a majority associated with suspected suicide attempt (52.48%). In total, 81.04% of reported exposures resulted in referral or management of patients at a healthcare facility. Common clinical effects observed included drowsiness (36.31%), tachycardia (20.92%), vomiting (5.49%), and slurred speech (5.19%). Intravenous fluids and activated charcoal were recommended and administered most commonly (8.02% and 5.02%, respectively). Only one death was noted.
**Conclusion:** While poisonings involving carisoprodol, meprobamate, methocarbamol, and metaxalone most commonly affect teenage individuals attempting suicide, the clinical effects associated with these SMRs may be managed acutely. Further knowledge gained from this study will aid future management of SMR toxicity in pediatric and adolescent patients by Poison Center personnel and healthcare providers.

### 065. Two Years of ToxRunner Question Usage Correlates with the Medical Toxicology Certification and In-Service Examinations

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**Background:** From 1974 to 2022, fewer than 750 physicians have achieved board certification in Medical Toxicology. The mobile digital question bank "ToxRunner" contains over 500 toxicology-themed practice questions intended to assist with exam preparation and medical knowledge. The application has been available for free on iOS and Android since October 2020.

**Methods:** The software developer registered a website and app store pages to distribute ToxRunner. The developer posted notifications on Medical Toxicology-related social media forums to inform fellows and attendings about ToxRunner. Users learned of ToxRunner's existence through these forums, word-of-mouth recommendations, and digital text messaging applications between colleagues. Anonymous utilization data was exported into a spreadsheet and correlated with in-service and medical toxicology certification examination dates.
**Results:** Over two years, 206 users registered and cumulatively completed 93,160 exam questions. Each user completed an average of 452 out of 504 (90%) available questions. 140 (68%) completed 100 or more questions, 79 (38%) completed at least all available questions, and 25 (12%) completed 1,000 or more questions. For the 2020 - 2022 exams, completed questions the week before and the week after demonstrated a rising sawtooth followed by a steep downslope pattern. The week before the 2020 certification exam, users completed 3,033 questions each day before and 652 after the exam. The week before the 2022 certification exam, users completed 1,711 questions each day before and 13 after the exam. The week before the 2021 in-service exam, users completed 246 questions each day before and 10 after the exam. The week before the 2022 in-service exam, users completed 626 questions each day before and 20 after the exam.
**Discussion:** Learners utilized an increasing number of practice questions daily before standardized toxicology examinations, and cumulatively completed over 93,000 ToxRunner questions.
**Conclusion:** Toxicology learners use ToxRunner to practice for standardized examinations.

### 066. T90X: Starting a Medical Toxicology Consult Service in 90 Days

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**Background:** Many large Emergency Departments (EDs) lack inpatient Medical Toxicology consult services despite treating a high volume of poisoned patients. The expectations of round-the-clock coverage and multiple toxicology consultants act as potential barriers.
**Research Question:** Can a small Medical Toxicology group establish a consult service within 90 days of conception?
**Methods:** A group of two medical toxicologists petitioned staff at a large academic tertiary referral center for Medical Toxicology consulting privileges. Privileges were requested under the umbrella of expanded ED credentials. We engaged stakeholders from the ED, the Medical Staff Office (credentialing), Clinical Decision Support, Medical Informatics, Coding and Billing, and Compliance. We disseminated instructions regarding consult workflow to the ED and directed all consults through the affiliated regional poison center. Specialists in Poison Information routed all consults through the on-call toxicologist, who dictated availability for in-person consults. Availability for in-person consultation after 5PM and on weekends was not guaranteed. Follow-up was provided, as needed, through the regional poison center.
**Results:** Time from first administrative contact to expanded privileging was 45 days. A Medical Toxicology consult order was added to the electronic medical record on day 78. Our first formal consultation was completed on day 79. We completed nine ED consults within our first 30 days of service. Of the six consult charges processed to date, four charges were reimbursed by insurance, with one insurance denial and one unpaid self-pay encounter. Mean reimbursement was $132.59 per accepted charge and $88.39 per consult overall. Hospital-wide credentialing for the Medical Toxicology consult service is in process as of day 115.
**Conclusion:** Our approach provides a reproducible model for ED Medical Toxicology consultation in hospitals without an existing service. Small toxicology groups or even singular toxicologists might adapt similar models. Engaging the regional poison center and key stakeholders was central to this process.

### 067. Preceding Educational Experiences In Medical Toxicology Fellows and Recent Fellowship Graduates: a Survey

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**Background:** Medical Toxicology is a small subspecialty. In 2020 there were 555 active board-certificated toxicologists, and in 2022 54 first-year fellowship positions were available. To continue to recruit strong applicants to maintain the specialty, it is imperative to understand the experiences that are most influential in leading a physician to pursue further training in Medical Toxicology.

**Research Question:** What preceding experiences were present for current and recent toxicology fellows?
**Methods:** This was a voluntary cross-sectional survey of medical toxicology fellows and recent fellowship graduates. The surveys were identical except cohort-specific questions about graduation year and current profession. The surveys were developed by the research team on REDCap and distributed by email to 91 current fellows and 192 recent graduates. Data were combined where appropriate to generate the descriptive statistics.
**Results:** A total of 126 subjects completed the survey (46 current fellows and 80 recent graduates). More than half of respondents (56.3%) developed an interest in toxicology during residency, and a majority of respondents (90.1%) completed a toxicology rotation during residency. A majority of respondents did not have a toxicology rotation (54.8%) or a toxicology consult service (62.7%) at their medical school institution. Less than half of respondents endorsed having a toxicology rotation in medical school (45.2%) or having received toxicology lectures in medical school (41.2%). When asked to describe what led to an interest in toxicology, the most common response was a mentor in the field, followed by exposure during a rotation.
**Conclusion:** Medical schools may be a target for outreach to generate interest in medical toxicology. Most respondents did not become interested in toxicology until residency, and this corresponds to their exposure to the specialty. A mentor played a significant role in helping many respondents decide to pursue further training in medical toxicology.

### 068. Opinion Influences Content in Social Media Discussions About 2,4-Dinitrophenol

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**Objective:** We previously demonstrated that users who endorse DNP use on social media mention more substances than those who condemn DNP use. The objective of this study was to determine whether the types of substances mentioned also vary with the user opinion on DNP use.
**Methods:** We analyzed a data set we previously described as a data set of online posts discussing DNP use. In the data set, each post is annotated as to whether the post explicitly promotes ("for") or discourages ("against") the use of DNP or takes no explicit stance ("tacit"). To each post we applied a named entity recognition (NER) module to identify substances. To assess the association between substance mentions and user opinion, we calculated the pairwise chi-squared statistic and used the Benjamini-Hochberg procedure to limit the false discovery rate to 0.05.
**Results:** We extracted 4,130 unique comments from publicly available online message boards ($n = 46$ "for", $n = 88$ "against", and $n = 3{,}996$ "tacit"). The NER module detected 248 unique substances, most commonly DNP, clenbuterol, and triiodothyronine. We validated the NER module on an independent data set of 1,176 comments (sensitivity 0.92, recall 0.88). "For" posts mentioned neurotransmitters (e.g., dopamine, serotonin; corrected $p$-value 0.03) more frequently than "against" or "tacit" comments. "Against" posts mentioned anabolic steroids and weight loss agents (corrected $p$-value $<0.01$ for each) more frequently than "for" or "tacit" comments.
**Conclusions:** Comments explicitly advocating for DNP use mention neurotransmitters more frequently than "against" or "tact" posts. Comments explicitly condemn DNP use and mention anabolic steroids and weight loss agents more frequently. Unequal sizes between groups decreased the power of our study. These results suggest that the rhetorical stance of users should be assessed when analyzing content social media commentary.

### 069. ADvanced Virtual Support for OpeRational Forces (ADVISOR) Toxicology Cases: a Retrospective Review of Military Related Cases Managed With Expert Toxicology Consultation

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**Background:** Military medicine is unique. Operations and medical care can be conducted in austere, resource limited environments. Despite these challenges, being able to continue to operate and care for military members at home and abroad remains essential to ensure mission success and access to expert consultation through ADVISOR is an important resource available.
**Research Question:** What are the characteristics of the medical toxicology patients managed with assistance through expert consultation via the ADVISOR line?
**Methods:** The (ADVISOR) program keeps an internal log of Operational Virtual Health Reports (OVHR) submitted by specialties consulted. We performed a quality improvement, internal retrospective review of the OVHRs submitted and classified under Toxicology subspecialty between December 2020 to April 2022.
**Results:** A total of five OVHRs were submitted and available for review. Case one: young male overdosed on 750 mg of diphenhydramine and presented with mild agitation and tachycardia. Unknown follow-up. Case two: 33 yo M, in sea water and felt sharp pain to left

foot, after sustaining puncture to left foot. Hot water submersion, wound care. Unknown follow-up. Case three: 22 yo M, hydrogen peroxide ingestion, two days prior to call. Unknown follow-up. Case four: Training exercise of simulated patient with retained bullet and concerns for lead toxicity. Case five: 27 yo M, altered mental status after smoking hookah. Unknown follow-up. Cases one through three, five the callers were from international areas with ongoing military operations. There were no telecommunication limitations documented for any of the calls. Treatment recommendations were documented to have been communicated to the medical teams using the ADVISOR line.

**Conclusion:** The ADVISOR line was used in real world operational scenarios for the management of patients with a reported toxicological exposure. Data captured from the cases were limited. Fellowship trained toxicologists were available for consultation using the ADVISOR line.

### 070. More Than a Little Hair Loss - A Case of Intentional Depilatory Agent Ingestion & Toxicity

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**Background:** Insoluble barium salts such as barium sulfate, commonly used as a radiocontrast agent in barium enemas, are not absorbable through the GI tract and are not associated with toxicity. In comparison, soluble barium salts such as barium sulfide, present in many depilatories, are absorbable through the GI tract and can lead to systemic toxicity when ingested.

**Methods:** This is a case report of systemic barium toxicity after an intentional ingestion. A 39-year-old man with a history of hypertension presented to the emergency department (ED) shortly after ingesting an unknown amount of Magic® Extra-Strength Shaving Powder mixed in milk, a depilatory agent containing barium sulfide and calcium hydroxide, in a suicide attempt with symptoms of abdominal pain, nausea, and vomiting. The patient was hypertensive (BP 176/113), his electrocardiogram (ECG) revealed a QTc of 540 ms with prominent U-waves and repolarization abnormalities, and his labs were significant for serum potassium of 2.8 mEq/L. The patient was treated with intravenous potassium chloride (KCl) for more than three days.

**Results:** ECG abnormalities resolved with potassium replacement during his hospital stay. The patient underwent esophagogastroduodenoscopy (EGD), which revealed diffuse gastritis of the stomach, and his abdominal pain resolved with supportive care including antacids. On hospital day four, his serum potassium remained within normal range without potassium supplementation, and he was subsequently discharged to inpatient psychiatry.

**Conclusion:** Hypokalemia resulting from barium toxicity is caused by an intracellular potassium shift without a total body potassium loss. Management of barium-induced hypokalemia rests primarily on good supportive care and potassium supplementation. Occult soluble barium salt ingestion may present as acute hypokalemia in the ED, especially with EKG findings of prominent U-waves that is out of proportion to the measured potassium level due to IK1 channel inhibition that contributes significantly to the appearance and size of U-waves.

### 071. What Are You Waiting For? Management Patterns of Multiple Magnet Ingestions Reported to New Jersey Poison Information and Education System (NJPIES)

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**Background:** Ingestion of multiple high-powered neodymium rare-earth magnets pose a significant risk for gastrointestinal (GI) injury such as bowel perforation or ischemia. Given the rising prevalence of significant morbidity associated with these ingestions, published guidelines recommend urgent endoscopic removal of all magnets within endoscopic reach in cases involving ingestions of two or more magnets (Hussain et al., 2012).

**Research question:** Do management patterns for multiple magnet ingestions align with current practice guidelines and does hospital length of stay (LOS) differ based on the initial emergency department (ED) approach?

**Methods:** This is a retrospective chart review of consecutive patient encounters reported to NJPIES between January 2021 through April 2022 involving multiple magnets ingestion. Potential cases were retrieved from the NJPIES poison control center call database, TOXICALL,® using substance codes relating to magnet or foreign body ingestion. Two-sample T-Tests were used to determine statistical difference in the hospital LOS between the group of patients receiving early emergent esophagogastroduodenoscopy (EGD) versus

those receiving watchful waiting or expectant management on initial presentation.
**Results:** There is a difference in the average LOS of 2.7 days ($p = 0.023$) longer in the expectant management group. There was no medical complication in either group. Subgroup analysis revealed a difference in the average LOS of 4.2 days ($p = 0.005$) in the expectant management group requiring colonoscopy as compared to those in the emergent EGD group that had successful removal of magnets from the stomach on initial presentation.
**Conclusion:** The initial ED decision to pursue expectant management instead of attempting emergent EGD removal of magnets results in significantly prolonged hospitalization, increased risk for readmission, as well as delayed procedures that were nevertheless eventually required for definitive removal of magnets due to non-progression along the GI tract. Adherence to published guidelines is encouraged.

**Day 2: Platforms, Abstracts 072-075**

### 072. Veno-venous Extracorporeal Membrane Oxygenation (VV-ECMO) Utilization in Acute Poisonings: a Retrospective Study of Extracorporeal Life Support Organization's ECMO Registry

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**Background:** Veno-arterial ECMO (VA-ECMO) is frequently utilized in drug-induced cardiogenic shock. However, there is limited literature describing patients requiring pulmonary support with veno-venous ECMO (VV-ECMO) in acute poisonings.
**Research Question:** To describe clinical characteristics of VV-ECMO utilization in acute poisoning and identify predictors of mortality.
**Method:** A retrospective study was performed using Extracorporeal Life Support Organization's (ELSO) ECMO registry. Acute poisoning in adults (age >18) receiving VV-ECMO were systematically identified using International Classification and Disease (ICD) codes for poisoning (ICD-9: 960-989, ICD-10: T36-T65) from 01/01/2003 to 11/30/2019. Two study investigators reviewed each case to determine study inclusion. Descriptive analysis, including chi-square and Wilcoxon rank-sum tests were performed comparing demographic and clinical parameters of survivors and non-survivors.
**Results:** One hundred seventeen VV-ECMO cases were identified and included in the analysis. The median age was 34.1 years and 69.2% ($n = 81$) were male. The most common substance exposure was opioid ($n = 53$, 45.3%) followed by neuroactive agents ($n = 17$, 14.5%). Misuse/abuse ($n = 35$, 29.9%) was the most common intention of exposure. The survival rate was 71.2% ($n = 84$). Survivors were cannulated for VV-ECMO significantly earlier after hospital admission (25 hours) compared to non-survivors (123 hours; $p = 0.015$). Larger proportion of survivors were suspected of/reported misuse/abuse (32.1% vs. 24.2%) and unintentional (25.0% vs. 18.2%; $p = 0.001$) exposures compared to non-survivors. There was no significant difference in hypotension, acid/base (pH, HCO3, lactate levels), or ventilatory/oxygenation parameters (pO2, pCO2, SaO2) between the groups. Mortality was associated with hyperbilirubinemia (odd ratios [OR]: 11.4, 95% confidence interval [CI]: 1.6-228.9), pneumothorax (OR: 8.6; 95% CI: 2.3-41.8) and infection (4.3; 95% CI: 1.3-15.5).
**Conclusion:** VV-ECMO is often utilized for indirect lung injury from substance exposure. Earlier time of ECMO cannulation was associated with survival while development of hyperbilirubinemia, pneumothorax and infection during ECMO were associated with increased odds of mortality.

### 073. Does Hyperkalemia Predict Development of Heart Blocks in Acute Yellow Oleander Poisoning Patients?

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**Background:** Yellow oleander (*Thevetia peruviana*) contains cardiac glycosides which result in arrhythmias, heart blocks and electrolyte imbalances. Association between serum potassium level and development of heart blocks is not elucidated.
**Hypothesis:** Does hyperkalemia developed within 24 hours of ingestion following acute yellow oleander poisoning predict development of heart blocks?
**Methods:** A prospective descriptive cohort study was carried out at Teaching Hospital Batticaloa, Sri Lanka, from 1st July to 31st October 2022 among patients admitted with acute yellow oleander poisoning. Patients were recruited if any of the following signs were present: bradycardia (<60 bpm), systolic blood pressure <80 mmHg, nausea,

vomiting, abdominal pain, diarrheoa xanthopsia, within 2 hours of admission. Serum potassium level was assessed at recruitment and 6 hourly, serial electrocardiograms done at recruitment and 4 hourly, for 24 hours. Association between hyperkalemia (serum potassium >5.5mmol/L) and development of heart blocks was calculated using a chi-squared test. Ethical Clearance was granted by the Ethics Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura.

**Results:** Among 65 consenting symptomatic patients recruited, 73.85% ($n = 48$) were males. 13.85% ($n = 9$) patients developed hyperkalemia while 9.23% ($n = 6$), 6.15% ($n = 4$) and 3.08% ($n = 2$) patients developed 1st, 2nd, and 3rd degree heart blocks respectively. Temporary cardiac pacing (TCP) was done in 7.69% ($n = 5$) patients and 1.53% ($n = 1$) died due to cardiac arrest. Hyperkalemia within 24 hours of admission was associated with development of heart block ($X^2(1,N = 65) = 9.5487$, $p = 0.0020$). Relative risk for development of heart blocks was 4.44 (95% CI) in patients who developed hyperkalemia.

**Conclusion:** Hyperkalemia can be considered as an early predictor of development of heart blocks in acute yellow oleander poisoning. Since the risk of development of heart blocks in patients with hyperkalemia is high, they should be closely monitored and managed at centers where facilities for TCP are available.

### 074. Number and Variety of Detected Substances in a Regional Sample of the Illicit Drug Supply

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**Background:** Analysis of specimens submitted by a syringe service program revealed a high rate of multi-substance combinations in drug materials.

**Research Question:** To determine the number and variety of substances in the current illicit drug supply in the Saint Louis Metropolitan Area.

**Methods:** This is a convenience sample of specimens intended for consumption that were voluntarily submitted to the syringe service program at the Missouri Network Outreach Center. These specimens were analyzed by gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-high resolution mass spectrometry (LC-QTOF-MS). Compound identification after GC-MS analysis was accomplished by spectral comparison to five different libraries, including the Cayman Chemical and SWG-Drug libraries. Compound identification by LC-QTOF-MS was accomplished using Information Dependent Acquisition (IDA).

**Results:** One-hundred and twelve products were analyzed between August 2021 and October 2022. The majority (68%) were complex combinations containing multiple classes of drug and multiple drugs of the same class within a single product. Ninety-five different substances were detected. The maximum number of drugs found in a single specimen was 33. The median number of drugs was 10 (IQR: 5-15). Fentanyl was the most frequently found substance (69% of specimens). In addition to fentanyl, there were eight unique fentanyl analogs and two fentanyl precursors. Cocaine (56%) and methamphetamine (55%) were the most frequently found stimulants, and ketamine (55%) was the most common hallucinogen. The para-intoxicant findings of lidocaine (41%) and xylazine (36%) are clinically significant as they possess innate toxicologic properties.

**Conclusion:** Illicit drugs frequently contain combinations of multiple intoxicating substances. Para-intoxicants may have synergistic or opposite effects of the intended drug of abuse. Clinicians should be vigilant for the presentation of mixed toxidromes in cases of illicit substance use.

### 075. Trends in Medical Outcomes: A Retrospective Review of the National Poison Data System 2007-2021

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**Background:** Data published by America's Poison Centers National Poison Data System (NPDS) reveals a decrease in human exposure calls to poison centers (PCs). However, medical toxicologists associated with PCs have voiced that the complexity of calls is increasing requiring increased physician consultation.

**Research Question:** Are medical outcomes of toxicological exposures reported to U.S. PCs becoming more severe?

**Methods:** We queried the NPDS for human exposures reported to U.S. PCs from 2007 to 2021. We assessed trends in medical outcomes (per 100,000 human exposures) among adult (>19 years) and pediatric (≤ 19 years) populations by reason for exposure. The percent changes are reported with the corresponding 95% confidence intervals (CIs).

**Results:** During the study period, death from unintentional exposures among adults increased 69% (95%CI=7%-167%). Analysis of outcomes in adult intentional exposures revealed an alarming increase in death (203%; 95%CI=171%-239%) and major outcomes (112%; 95%CI= 51%-197%).

Intentional exposures resulting in moderate outcomes increased 37% (95%CI=15%-63%). Between 2007 and 2021, pediatric unintentional exposures resulting in major outcomes dramatically increased 163% (95% CI =99%-249%). Trends in pediatric intentional exposures revealed increases in death (40%; 95%CI=1%-94%), major outcomes (82%, 95%CI=4%-220%), moderate outcomes (37%; 95%CI=12%-67%), and minor outcomes (22%; 95%CI=4%-44%). Trends in exposures not followed by specialists in poison information due to non-toxicity (63%; 95%CI=51%-84%) or due to low potential for toxicity (44%; 95%CI=33%-61%) both significantly declined.

**Conclusion:** Analysis of PC trends over the past 15 years revealed a trend of worsening severity of medical outcomes for human exposures reported to PCs. Increases in severe medical outcomes are observed more in intentional exposures in both the adult and pediatric populations. U.S. PCs, despite a drop in calls, are being increasingly utilized for more complex cases for which associated medical toxicologists are an integral part of the management team.

## Day 2: Moderated Posters, Abstracts 076-082

### 076. Cyanide Countermeasure Development: Efficacy of Intramuscular Dimethyl Trisulfide for Oral Cyanide Toxicity in Swine

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**Background:** Cyanide can be weaponized and in a mass casualty scenario, current countermeasures that require advanced procedures such as IV or IO access have limited practical application. A countermeasure that can be administered intramuscularly such as dimethyl trisulfide (DMTS) may have more practical applications in the mass casualty, prehospital and battlefield scenarios for severe, acute cyanide toxicity.

**Hypothesis:** We hypothesize that animals exposed to a lethal dose of oral cyanide receiving IM DMTS will have improved survival to no treatment controls at 60 minutes.

**Methods:** This is an animal study assessing the efficacy of IM DMTS vs no treatment on survival in a large, translational animal model of severe oral cyanide toxicity. The primary outcome is survival at 60 minutes. The secondary outcomes include laboratory values, degree of acidemia and lactate concentrations. The experiments were performed at CIRS laboratory on Lackland AFB.

**Results:** At 60 minutes, the group of animals treated with IM DMTS had significantly higher survival compared to the control group. The control group had significantly higher lactate concentrations compared to the group of animals treated with IM DTMS.

**Conclusions:** IM DMTS was efficacious in improving survival in animals exposed to a lethal dose of oral cyanide when compared to controls. Animals treated with IM DMTS had lower lactate concentrations compared to control animals.

### 077. QRS Widening as a Risk Factor for Adverse Cardiovascular Events in Bupropion Exposures: a ToxIC Registry Study

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**Background:** QRS widening on electrocardiogram (ECG) is associated with adverse cardiovascular events (ACVE) in sodium channel blockade. Bupropion toxicity causes QRS widening via the blockade of gap junctions, and it is unknown whether QRS widening in this setting is associated with ACVE.

**Hypothesis:** QRS widening independently predicts ACVE in single substance bupropion exposures.

**Methods:** This is a retrospective analysis of the Toxicology Investigators Consortium (ToxIC) registry. We included acute and acute-on-chronic single substance bupropion exposures in adults (19 years or older) from January 1st, 2010 to December 31st, 2021. Patients with signs/symptoms marked as "Unlikely related" to exposure were excluded. The independent variable was QRS widening (> 120 ms). The primary outcome was ACVE, defined as the presence of any of the following: 1) Ventricular dysrhythmia, 2) Treatment with vasopressors, 3) Myocardial injury, or 4) Cardiac arrest, defined as treatment with cardiopulmonary resuscitation (CPR) or death during hospitalization. To test the association between QRS widening and ACVE, we conducted a propensity score matched analysis to adjust for the following potential cofounders, selected a priori: age, seizures, tachycardia (>120 bpm), and QTc prolongation (>500 ms). Patients with and without QRS widening were matched using a 1:1 nearest neighbor approach.

**Results:** We identified 416 cases for analysis. 410 (98.6%) were 19 – 65 years old; 229 (55.1%) were female. 18 (4.33%) patients had QRS widening; 16 (3.85%) patients experienced ACVE. The standardized mean differences of all covariates between matched patients were <10%, reflecting excellent

balance. We found a non-significant estimate that risk of ACVE would be 8.2% greater if all patients had QRS widening than if no patients had QRS widening (Average Effect 8.2%, 95% CI 6.6% - 23.1%, $p$ = NS).
**Conclusions:** QRS widening was not independently predictive of ACVE in bupropion exposures; further research with larger sample sizes is needed.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 078. Interspecies Differences in Rattlesnake Envenomations in the Western United States Reported to the North American Snakebite Registry

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**Background:** Rattlesnake envenomations produce cytotoxic, hemotoxic, neurotoxic, and systemic effects. While some effects have been associated with particular species of rattlesnake, such as neurotoxicity following Mohave envenomation, comparison of clinical effects between species has not been studied.
**Hypothesis:** There are significant interspecies variations in clinical effects from rattlesnake envenomation.
**Methods:** This is a cohort study of patients reported to the North American Snakebite Registry with envenomation by a positively identified species of rattlesnake in the western United States. Snakes were "western" if the range was entirely west of the Mississippi River. Only species with greater than 15 cases were included to allow for statistical comparisons using Pearson's chi-squared test.
**Results:** 173 cases met inclusion criteria. Five western species had over 15 cases identified and included 76 *Crotalus atrox*, 31 *C. viridis*, 29 *C. lutosus*, 20 *C. scutulatus*, and 17 *C. helleri*. Statistically significant differences were seen between species for the following: *C. scutulatus* was associated with more hypotension than *C. lutosis* (25% vs. 0%, $p$ = .008); *C. atrox* had more hypofibrinogenemia than *C. scutulatus* (25% vs. 0%) and C. viridis (3.4%) ($p$ = 0.002). *C. atrox* was also associated with more bleeding and necrosis than *C. viridus* (23.7% vs. 3.2%, $p$ = 0.014; and 18.4% vs. 0%, $p$ = 0.003; respectively); *C. helleri* was associated with more neurotoxicity than *C. atrox* (52.9% vs. 5.3%, $p$ < 0.001).
**Conclusions:** Comparison of clinical effects following envenomation by western species of rattlesnakes reported to the North American Snakebite Registry demonstrated statistically significant differences in rates of hypotension, hypofibrinogenemia, bleeding, necrosis, and neurotoxicity between species.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 079. Comparing Cost and Efficacy of Fab2AV vs FabAVTreatment of Copperhead Envenomation—One Center's Practical Experience

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**Background:** This year, Crotalinae equine immune F(ab')2 antivenom (Fab2AV,Anavip®) become a treatment option (in addition to ovine polyvalent crotalidae antivenom FabAV (CroFab®)) at a tertiary rural/urban hospital for copperhead (Agkistrodon contortrix) envenomation. This report describes our experience in care, dosing, cost, and charge with these antivenin treatments.
**Methods:** This was an uncontrolled, retrospective observational cohort study of copperhead envenomations where antivenin was considered between April-October 2022. Each patient's chart was reviewed for indication, severity of bite, bite location, lab data (platelet count, PT, fibrinogen, TEG), hospital length of stay, type and total dose of antivenin, adverse reaction, and calculated cost and charge of antivenin.
**Results:** Thirty-one patients were seen for copperhead snake bites: 19 adults and seven children, all had complete records; five were excluded. Seven adults got Fab2AV: five (10 vials), one (13 vials), one (14 vials). Twelve adults got FabAV: three (4 vials), one (10 vials), six (12 vials), two (18 vials). In children, two got Fab2AV (10 vials). Five children got FabAV: three (10 vials), one (16 vials), one (18 vials). There was no difference in age, sex, lab abnormalities, hospital length of stay (one day), or number of total vials given (average: FabAV 11.4 vs. Fab2AV 10.7) between antivenin groups. One FabAV patient had urticaria, one patient had urticaria to both antivenins. Average hospital cost of Fab2AV $13,054 (95% CI = $11,749 – $14,358) was less than FabAV at $35,178 (95% CI = $27,679 – $42,677; $p$ <0.001). Average hospital charges with Fab2AV $23,754 (± $3317($21,380 - $26,127)) was less than FabAV $48,043 (± 18,395($38,895 - $57,191)) $p$ <0.001.

**Conclusion:** In similar patients, receiving recommended dosing regimens, there was equivalent response, but significant difference in cost and charge between the two antivenins. Factors such as administration ease and financial burden should be included when deciding on treatment for copperhead snakebite.

### 080. Comprehensively Treating the Poisoned Patient on a Med Psych Unit

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**Background:** Patients admitted for toxicologic disorders, including substance use disorders (SUD), are among the highest utilizers of acute inpatient medical services, and are at risk of poor health outcomes. A traditionally siloed hospital system is suboptimal for these patients' concomitant medical and psychiatric needs. We describe a medicine-psychiatry unit (MPU) developed to manage patients presenting with conditions that require simultaneous medical and psychiatric management, including sequelae of SUD.
**Methods:** A transdisciplinary treatment approach is used. Medical hospitalists collaborate with psychiatrists and clinical pharmacists. Daily interdisciplinary rounds address social and nursing concerns. An inpatient Toxicology/Addiction consult service is readily available for direct bedside consult or via phone. Bedside nurses are equipped with psychiatric training in communication strategies and skills. Psychologist consultation is available. Toxicologic admissions include various types of ingestions: self-harm, adverse effects of substance use/misuse, and withdrawal syndromes. Patients admitted to a 20-bed MPU were compared to those in the remaining medical-surgical units within an 886-bed tertiary-care-academic medical center. Using discharge data from January 2019 through February 2022, patients with SUD were identified by diagnosis codes F10.xx-F19.xx, excluding F17.xx (nicotine use).
**Results:** 1,725 patients were included in the MPU and 27,312 patients in the non-MPUs. 50% of MPU patients were associated with any SUD diagnosis, compared to 13.5% of non-MPUs. Of these admissions with SUD associated diagnoses, the length of stay was 5.9 days for MPU discharges and 7.9 days for non-MPUs. Mood disorder and psychotic disorder was 72.4% and 17.2% of SUD patients on the MPU and 46.9% and 3.8% on non MPUs.
**Conclusions:** The MPU has a high proportion of SUD related diagnoses with associated mood and psychiatric illnesses, highlighting the often-overlooked intersection between toxicology and mental health. Patients with toxicology-focused admissions can benefit from the synergistic model of a med-psych unit, as evidenced by a favorable LOS.

### 081. Clinical Features of Benzonatate Poisoning Cases Reported in the Toxicology Investigators Consortium Registry

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**Background:** The popularity of benzonatate as a prescription cough medicine has been increasing significantly over the last 20 years and it is now one of the most common prescription cough medications provided by primary care physicians. Unfortunately, benzonatate is metabolized to a local-anesthetic analog that can cause severe symptoms in overdoses or when accidentally ingested.
**Research Question:** We sought to characterize the severity, clinical presentations, course, and interventions employed in benzonatate overdoses in cases submitted to the Toxicology Investigators Consortium (ToxIC) database and identify factors associated with clinical outcome.
**Methods:** We obtained data from the ToxIC registry to carry out a descriptive study of benzonatate poisoning cases managed by medical toxicologists between 2012 and 2022. Cases were included if benzonatate was listed as an agent. We used fisher exact tests where appropriate to test for associations.
**Results:** There were 59 cases in the ToxIC database that met our inclusion criteria. Most cases of benzonatate ingestion were attempts at self-harm (39/59) and occurred among teenagers aged 13-18 (33/59). Over one third of cases were admitted to the ICU. The most common presenting signs included depressed mental status (21/59), and arrhythmia (17/59). Seizures occurred in 4 patients, 12 patients required ventilator management, four patients required CPR and three died. QTc or QRS prolongation was common, occurring in 9 patients and was associated with ICU admission (OR=5.1, $p$=0.05). Pharmacological intervention was heterogeneous, and often driven by co-ingestions. Sodium bicarbonate was the most common directed therapy, and use was strongly associated with QRS or QTc prolongation (OR=30, $p$=0.0005). No patients received Intralipid.
**Conclusion:** Benzonatate poisoning is associated with a high rate of severe presentations including three deaths. Many cases required ICU admission, ventilatory management, or CPR. Sodium bicarbonate was employed for treatment, but despite its theoretical value, Intralipid use was not reported.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 082. Patterns of Buspirone Exposures Reported to the U.S. Poison Centers

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**Background:** Misuse of pharmaceutical drugs continues to be a significant public health crisis globally. In the United States (U.S.), there were more than 10 million buspirone prescriptions dispensed in the year 2020.
**Research Question:** What are the recent trends in buspirone exposures reported to U.S. Poison Centers (PCs)?
**Methods:** The National Poison Data System (NPDS) was queried for buspirone exposures reported to U.S. PCs from 2011 to 2021. We identified and descriptively assessed the relevant demographic and clinical characteristics. Poisson regression models were used to evaluate the trends in the number and rates (per 100,000) of buspirone exposures.
**Results:** There were 60,091 buspirone exposures reported during the study period. Among these, 62.1% cases were reported from acute care hospitals and 30.2% were single substance exposures. Ages between 20 and 29 years (20.6%) constituted the most common age group. Females accounted for 62.6% of cases. Most exposures occurred in a residence. Ingestion was the most common route of exposure. The most frequently co-occurring substances were atypical antipsychotics (17.5%). Suspected suicides (58.3%) and therapeutic errors (18%) were the most common reasons for exposure. Approximately 18% of cases were admitted to the critical care unit while 19.4% were admitted to a psychiatric facility. Major effects and fatalities were uncommon (4.8% and 0.3%, respectively). Intravenous fluids and benzodiazepines were the most frequently used therapy. Tachycardia, respiratory depression and drowsiness were the most common clinical effects. The frequency of buspirone exposures increased by 144.2% (95% CI: 113.4%, 167.4%, $p < 0.001$) while the rate increased by 153.1% (95% CI: 132.2%, 179.2%, $p < 0.001$).
**Conclusions:** The number of buspirone exposures increased significantly over the study period. Buspirone exposure with adverse effects is a growing issue, but the severity of clinical effects is low.

## Day 2: Posters, Abstracts 083-135

### 083. Combined Ingestion of Methanol and Ethylene Glycol: a Cautionary Tale of Unit Interpretation

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**Background:** Combined ingestions of methanol and ethylene glycol (EG) are rarely reported.
**Methods:** Chart review of a 28-year-old man who reported ingesting a mixture of antifreeze and bleach 16 hours prior to presentation. Vital signs were BP 112/67 mmHg, HR 57 beats/min, temp 97.8 °F, RR 16 breaths/min, and SaO2 95% on RA. The patient was awake, alert, fully oriented, and in no distress. Initial labs demonstrated an anion gap of 15 mEq/L, serum CO2 19 mEq/L, creatinine 1.15 mg/dL, and an elevated osmolar gap of 147 mOsm/Kg (BUN 6 mg/dL, glucose 93 mg/dL, ethanol zero mg/dL, measured serum osmolality 427 mOsm/kg). Fomepizole 15 mg/kg, thiamine 100 mg, pyridoxine 100 mg were administered. EG and methanol concentrations were sent to a reference lab.
**Results:** EG and Methanol concentrations resulted at 152 mg/dL and 0.274 g/dL (units as reported), respectively. While the methanol concentration was initially interpreted as negligible, the magnitude of the osmolar gap was not fully explained by the EG concentration alone, prompting review of the methanol result. On recognition of the misinterpretation of the units, the recommendations were modified to include hemodialysis. The patient underwent hemodialysis on HD1. Repeat ethylene glycol and methanol concentrations were < 20 mg/dL and 0.053 g/dL (53 mg/dL), respectively. Hemodialysis was repeated on HD2 and repeat methanol concentration was 0.011 g/dL (11 mg/dL). The patient was transferred to psychiatry on HD5 without sequelae.
**Conclusion:** The difference in reported units of the EG and methanol concentrations and the rarity of combined ingestions of multiple toxic alcohols lead to initial misinterpretation of the methanol level as negative. This case reinforces the need to verify units for proper interpretation.

## 084. Comparison of Ethanol Withdrawal Management Protocols: SEWS-Phenobarbital on a Medical Toxicology Admitting Service vs Standard Hospital CIWA-Benzodiazepine Protocol

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**Background:** We compared quality outcomes of Alcohol Withdrawal Syndrome (AWS) management between a primary medical toxicology admitting service and other inpatient admitting services within a hospital network.
**Methods:** Retrospective, single center observational study between April 2021 - August 2022. The medical toxicology service utilizes a Severity of Ethanol Withdrawal Scale (SEWS)-phenobarbital symptom-triggered monotherapy protocol at their 16-bed withdrawal management unit, whereas the remainder of the hospital network utilizes a conventional Clinical Institute Withdrawal Assessment (CIWA)-benzodiazepine (BZD) protocol. Quality data was obtained via electronic medical records comparing relative length of stay (LOS) and readmission rates between the withdrawal management unit and network inpatient and intensive care settings for similar patients with AWS, querying specific medical diagnoses of alcohol withdrawal, delirium tremens, seizure, Wernicke Encephalopathy, Wernicke-Korsakoff Syndrome, alcoholic ketoacidosis, atrial fibrillation, pancreatitis, transaminitis, kidney injury, dehydration, and overdose. An expected LOS index was calculated using a formula accounting for the aforementioned co-morbidities; a value of one indicates the expected hospital stay. Seven-day bounce-back and 30-day readmission rates (for any reason) were also examined.
**Results:** During the study period, the medical toxicology service admitted an average of 59 patients per month (range: 31-90). Average LOS index was 0.86 for the withdrawal management unit, compared to 1.28 for the rest of the network. Seven-day bounce-back rate for the withdrawal management unit was 4.9%, compared to 8.35% for the rest of the network. Thirty-day readmission rate for the withdrawal management unit was 5.55% compared to 10.56% for the rest of the network. No readmissions were related to any recurrence of withdrawal symptoms in the absence of recidivism.
**Conclusion:** The medical toxicology withdrawal management unit, using a SEWS-phenobarbital protocol, showed decreased LOS, seven-day bounce-backs, and thirty-day readmission rates compared to inpatient hospital and intensive care unit settings for the same defined population of patients.

## 085. Adjunctive 4-Methylpyrazole Therapy in Massive Acetaminophen Poisoning Aided in Preventing Severe Liver Injury

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**Background:** 4-methylpyrazole is an emerging adjunctive therapy for acetaminophen poisoning due to its ability to inhibit cytochrome P450 enzyme CYP2E1, which is responsible for formation of the toxic acetaminophen metabolite N-acetyl-p-benzoquinoneimine.
**Hypothesis:** Adjunctive 4-methylpyrazole helps prevent hepatic injury in massive acetaminophen poisoning.
**Methods:** This is a single patient chart review. A 59-year-old male presented after ingesting 100g of acetaminophen and 100 g of ibuprofen. He was intubated for encephalopathy. Initial vital signs included temperature 35.6C, heart rate 82 bpm, and blood pressure 97/53 mmHg. Presenting laboratory findings included ALT 123 U/L (baseline 23 U/L), AST 100 U/L (baseline 20 U/L), bicarbonate 15 mmol/L, INR 1.1, and five-hour serum acetaminophen concentration 267 mcg/mL. Patient was started on N-acetylcysteine (NAC) and given 4-methylpyrazole 15 mg/kg before transfer to a tertiary care center.
**Results:** After transfer, NAC was continued at 12.5 mg/kg/hr. 4-methylpyrazole was given for an additional five doses at 10 mg/kg and three doses at 15 mg/kg. Acetaminophen concentration peaked at 535 mcg/mL 24 hours post-ingestion. Acetaminophen became undetectable at 105 hours post-ingestion and both NAC and 4-methylpyrazole were stopped. Peak AST and ALT occurred at presentation with return to normal range at 36 hours and 97 hours post-ingestion, respectively. Bicarbonate nadir occurred at 24 hours post-ingestion at 9 mmol/mL. Continuous venovenous hemodiafiltration (CVVHDF) was started at 31 hours post-ingestion for refractory acidosis and was stopped at 55 hours post-ingestion. INR remained in normal range. He was extubated on hospital day 2 and discharged from medicine-psychiatry on hospital day 25.
**Conclusion:** In this case of massive acetaminophen overdose, adjunctive 4-methylpyrazole with NAC appears to have helped prevent significant liver injury. CVVHDF likely did not contribute to acetaminophen clearance as

acetaminophen was detectable for 50 hours after CVVHDF ended.

### 086. Exchange Transfusion for Acetaminophen-Induced Methemoglobinemia and Hemolysis in a Patient with Undiagnosed G6PD Deficiency

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**Background:** Methemoglobinemia following acetaminophen overdose is rare and usually occurs in patients with underlying glucose-6-phosphate dehydrogenase (G6PD) deficiency. Methylene blue is the typical treatment for methemoglobinemia but is contraindicated in G6PD deficiency due to risk of hemolysis from oxidant stress. Red cell exchange transfusions have been utilized in cases of refractory methemoglobinemia and hemolysis. We present the first reported use of exchange transfusion to treat acetaminophen-induced methemoglobinemia and hemolysis in the setting of undiagnosed G6PD deficiency.
**Case Report:** A 27-year-old male presented to a community hospital after an intentional ingestion of 35 grams of acetaminophen in a suicide attempt the day prior. NAC was initiated and the patient was transferred to our tertiary care hospital 3 days later for worsening hepatotoxicity. On arrival he had heart rate 118 bpm, blood pressure 157/83 mmHg, and pulse oximetry showing 82% on high flow nasal cannula. Laboratory analysis included a methemoglobin level of 11.7%, hemoglobin 9.7 g/dL, total bilirubin of 29.5 mg/dL, AST 6681 U/L, ALT 4825 U/L, INR 3.4, and Cr 5.68 mg/dL, consistent with hemolytic anemia in the setting of hepatic failure and acute kidney injury. Hematology was consulted. A peripheral smear showed spherocytes and bite cells consistent with G6PD deficiency. High-dose NAC infusion of 14 mg/kg/hr was utilized to decrease oxidant stress. Due to declining hemoglobin (to 8.2 g/dL), rising methemoglobin (to 11.7%), and clinical deterioration, a 6 unit exchange transfusion was performed, resulting in improved oxygen saturation and methemoglobin levels. The patient underwent liver transplantation and had a prolonged post-operative course.
**Conclusion:** Underlying G6PD deficiency should be suspected when hemolysis and methemoglobinemia complicate acetaminophen overdose. Exchange transfusion should be considered in severe cases. High-dose NAC may be beneficial by providing reduced glutathione, which is not regenerated in G6PD deficiency.

### 087. Pharmacokinetic Modeling of a Single Massive Acetaminophen Ingestion Treated with High Dose N-Acetyl Cysteine and 4-methylpyrazole

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**Background:** 4-methpyrazole inhibits CYP2E1, a cytochrome that metabolizes acetaminophen (APAP) to n-acetyl-p-benzoquinone-imine (NAPQI). CYP2E1 blockade may be a useful adjunct in massive APAP overdoses. A 37-year-old male presented after being found down after drinking alcohol around empty pill bottles. On presentation, he was intubated for airway protection. He was hypothermic, tachycardic, tachypneic, and hypertensive. Labs showed: pH 7.09, pCO2 40, bicarbonate 12, AG 24, venous lactate 7.4, ALT 100, AST 95, whole blood APAP was 707 ug/mL. The patient was given activated charcoal 50 g via NGT, oral NAC 140 mg/kg via NGT, IV NAC 150 mg/kg over 1 hour followed by IV NAC 25 mg/kg/hr, and fomepizole 15 mg/kg IV followed by 10 mg/kg every 12 hours for four doses. The patient received hemodialysis 12 hours after presentation for refractory acidemia. He was extubated the next day. LFTs reached a zenith of 3000s on admission day two, and on day three, APAP was undetectable.
**Research Question:** What is the rate of APAP elimination in massive APAP with concomitant CYP2E1 blockade with 4-methylpyrazole?
**Methods:** Serial APAP concentrations were plotted against time in minutes. Linear regression analysis for phase zero metabolism and logistic regression analysis for phase one metabolism was performed using Graph Pad Prism 9.
**Results:** For phase zero metabolism, linear regression analysis yielded the following formula: [APAP mcg/mL] = -0.7567*t + 703.8 (R^2=0.99982). Once the concentration was below 200, logistic regression analysis yielded the following formula: y[APAP mcg/mL]=-4.4+(663+4.4)e^(-0.001957*x), which represents an elimination half-life of 254 minutes (R^2=0.9969).
**Conclusions:** APAP initially had zero-order kinetics. Once the enzymatic pathways were no longer saturated, APAP reverted to first-order kinetics. Despite CYP2E1 blockade, high dose NAC, and dialysis, the patient still developed clinically significant hepatotoxicity.

## 088. Consensus Guidelines on the Management of Acetaminophen Poisoning in the US and Canada

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**Background:** The US and Canada currently have no formal published national guidelines for specialists in poison information (SPI), nor for emergency department (ED) or inpatient management of acetaminophen poisoning, resulting in significant variability in management.
**Objective:** To develop consensus guidelines for the management of acetaminophen poisoning in the US and Canada.
**Methods:** All four clinical toxicology societies (America's Poison Centers (APC), American Academy of Clinical Toxicology (AACT), American College of Medical Toxicology (ACMT), Canadian Association of Poison Control Centers (CAPCCT) selected participants ($n = 21$) to participate in a modified-Delphi process led by a non-voting chairperson. Unique to this effort was the collection of guidelines from most poison centers ($n = 84$ guidelines) in addition to systematic collection and review of the medical literature.
**Results:** Over a period of nine months, the panel developed 14 guidelines for the out-of-hospital and ED/inpatient management of acute as well as repeated ingestion, extended-release formulation, high-risk ingestion, coingestion of anticholinergic or opioids, age less than six years, pregnancy, weight above 100 kg, and intravenous acetaminophen. Differences to current US practice include defining acute ingestion as an ingestion presentation from 4 to 24 hours after initiating overdose. A modified nomogram was developed for assessment of acetaminophen concentrations. Other recommendations include specific criteria for home management and ED triage, laboratory evaluation and monitoring parameters, defining the role of gastrointestinal decontamination, detailed management of n-acetylcysteine treatment, associated adverse effects, and stopping criteria, and criteria for consultation with a toxicologist. The term massive ingestion was replaced with high-risk ingestion denoted by a specific nomogram line, defining the term, and adding specific treatment considerations, including n-acetylcysteine dosing, fomepizole administration, and considerations for extracorporeal elimination and transplant evaluation.
**Conclusion:** The guidelines offer a consistent framework and evidence-based recommendations for medical, pharmacy, and nursing education and practice to optimize care of acetaminophen-poisoned patients.

## 089. Extracorporeal Liver Support Techniques in the Treatment of Naproxen Overdose

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**Background:** Naproxen, an over-the-counter nonsteroidal anti-inflammatory drug (NSAID), is highly protein bound (> 90%) and has a prolonged absorption which delays peak concentration. Severe poisoning with naproxen can result in high anion gap metabolic acidosis, acute renal failure, and death. Hemodialysis and hemofiltration have been previously used to manage metabolic acidosis and renal failure. In our case, extracorporeal liver support techniques, Single Pass Albumin Dialysis (SPAD) and Molecular Adsorbent Recirculating System (MARS), not only enhanced elimination of naproxen as evident by pre- and post-filtration concentrations, but the patient improved clinically.
**Methods:** A 16-year-old female presented to an outside ED three hours after intentional ingestion of 41.8 grams of naproxen (656 mg/kg; 63.7 kg) and two grams of ibuprofen. Initial labs were unremarkable. Poison center was notified and recommended activated charcoal, however, the patient refused it. Upon arrival at the children's hospital (eight hours after ingestion), the patient was agitated, not oriented, and lethargic, without reported seizure activity. She was

hypotensive with a lactic acidosis (9.51 mmol/L) and was transferred to the ICU where she was started on an epinephrine infusion and intubated. EKG was a sinus rhythm with normal intervals. Echocardiogram showed normal function. Continuous venovenous hemofiltration was started on hospital day one with albumin in the dialysate (SPAD) and MARS the following two days to eliminate protein bound NSAID. Naproxen and ibuprofen concentrations were measured.
**Results:** Initial naproxen concentration was 244.7 mg/mL and decreased to 26.7 mg/mL over the next 48 hours. The patient was extubated, and epinephrine infusion was stopped. She was transferred to a psychiatric facility.
**Conclusion:** Extracorporeal liver support techniques, Single Pass Albumin Dialysis (SPAD) and Molecular Adsorbent Recirculating System (MARS) can be considered early in the treatment of massive NSAID overdose and other highly protein bound drugs with toxic clinical sequelae.

### 090. Aspirin Smoothie Ingestion: The Blender Makes All the Difference

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**Background:** Aspirin has many formulations and depending on the formulation the absorption and kinetics can vary. Immediate release tablets are absorbed quickly, and peak serum levels are reached in 30 minutes and follow first order kinetics.
**Hypothesis:** Does the blending of aspirin alter the kinetics of absorption?
**Methods:** This is a single patient chart review. A 29-year-old female with past medical history of schizophrenia presented to the emergency department (ED) after ingestion of 500 tablets of 325 mg of aspirin and 300 tablets of 25 mg of trazodone that she blended with water. The time of ingestion was at 3 pm and arrival to the emergency room was 5 pm. On arrival to the ED vital signs were heart rate of 108, blood pressure of 131/87, respiratory rate of 20, temperature of 98.3 F, 100% O2 saturation on room air. She received 100 grams of activated charcoal on arrival.
**Results:** Initial salicylate level was 63.9 mg/dL, which was drawn two hours after ingestion. The patient was started on a sodium bicarbonate drip. She had a seizure at 7:30 pm and was intubated. Repeat salicylate level two hours after initial was 110.6 mg/dL. The patient was transferred to the intensive care unit by air ambulance. Next level result was 99.6 mg/dL at 2:30 am. She received dialysis at 5:30 am and the next level resulted at 9:00 am, which was 51 mg/dL. The patient did not receive additional dialysis, and level eventually was undetectable. She was extubated the next morning and downgraded to the floor.
**Conclusion:** The absorption kinetics of aspirin is dependent on its formulation. This case report demonstrates extremely rapid absorption of blended aspirin shortly after ingestion and has not previously been described in the literature.

### 091. Methylenedioxymethamphetamine (MDMA)-Adulterated Instant Coffee Causing Serotonin Toxicity in Two Patients

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**Background:** Methylenedioxymethamphetamine (MDMA) is a drug of abuse with sympathomimetic and serotonergic properties. Individuals exposed to this drug can exhibit life-threatening sympathomimetic toxidrome and serotonin toxicity.
**Hypothesis:** While not widely known to occur in the United States, instant coffee packets may be used as a vehicle for transporting illicit drugs, and unintentional ingestion of coffee prepared from these packets can cause drug toxicity.
**Methods:** This is a chart review of two related patients who presented simultaneously to an emergency department (ED) with altered mental status. One was a 53-year-old woman with a past medical history (PMH) of venous thromboembolism; another was a 76-year-old woman (the mother of the first patient) with a PMH of hyperlipidemia and asthma. Neither was prescribed serotonergic medications. Both patients were referred to the ED shortly after drinking their tenant's packet of "Aik Cheong Instant White Coffee four-in-one Hazelnut Flavor" prepared in water. Visual inspection of a coffee packet from the same box revealed evidence that it had been cut open on one side and resealed. Both patients were disoriented and had mydriasis, ocular clonus, diaphoresis, and tachycardia; the older patient had rigidity; the younger patient had a temperature of 38.9 degrees Celsius. The patients were admitted to intensive care and treated supportively with benzodiazepines.
**Results:** Urine drug screens were both positive for amphetamines. Tests of initial ED blood and urine in both patients were positive for MDMA, as were the contents of the other unused instant coffee packet. Both patients improved clinically after 24 hours and were discharged home after one week. Police were notified.

**Conclusion:** Instant coffee packets are among several potential vehicles used for the transport of illicit drugs. Providers should be aware of this practice, as unsuspecting persons may consume the contents of these packets and experience toxicity.

### 092. Amphetamine Toxicity Leading to Posterior Reversible Encephalopathy Syndrome

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**Background:** Posterior Reversible Encephalopathy Syndrome (PRES) is a clinical and radiologic syndrome characterized by clinical signs of encephalopathy and reversible leukoencephalopathy on imaging. We present a case of a 14-year-old female diagnosed with PRES following acute amphetamine overdose which contributes to the limited literature describing PRES in pediatric patients following an acute overdose.
**Method:** This is a single patient chart review. A 14-year-old female presented to the emergency department after an isolated intentional ingestion of 400 mg total of extended-release amphetamine/dextroamphetamine. Her initial presentation was notable for a headache and mydriasis with a systolic blood pressure of 190/118 mmHg, heart rate of 69 bpm, and temperature of 36.7 degrees C. By 2 hours post ingestion, she developed some confusion and had two episodes of emesis. A urine amphetamine concentration was measured at 5,000 ng/mL by GC/MS. Labs and an EKG were otherwise unremarkable. She received a total of 1.5 mg of lorazepam and was transferred to a tertiary referral center. By arrival, her vital signs normalized but she developed bilateral vision loss confirmed with optokinetic drum testing. An MRI of the brain and orbit with and without contrast was ordered showing cortical and subcortical hyperintensities on T2/FLAIR in the frontal, occipital, and parietal regions consistent with PRES.
**Results:** With continued supportive care, the patient's vision began to improve by 18 hours and returned to baseline by 48 hours. An exam by neuro-ophthalmology was normal at 60 hours post-ingestion and a repeat MRI at two weeks showed complete recovery.
**Conclusion:** This case identifies PRES as a potential complication of acute amphetamine overdose and suggests the possibility of developing PRES with other toxic exposures resulting in increased sympathetic tone or hypertension. Suspected or identified PRES may warrant deviations from the routine care for patients presenting with sympathomimetic overdose.

### 093. Use of Natural Language Processing Text-Mining to Identify Differences in the OVERDOSAGE Section of Amphetamine and Methamphetamine Drug Labels

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**Background:** The OVERDOSAGE section of prescription drug labels containing the same active ingredient in the same formulation should be identical. Natural language processing (NLP) text-mining rapidly identifies differences.
**Purpose:** Apply text-mining to search DailyMed to identify differences in the OVERDOSAGE section of amphetamine and methamphetamine drug labeling.
**Methodology:** An NLP text-mining tool queries the OVERDOSAGE sections of drug labeling. The query uses the unique ingredient identifier (UNII) code to identify drugs with the same active ingredient. Amphetamine and methamphetamine drug labeling versions were identified, and they were manually analyzed for differences in the OVERDOSAGE section.
**Results:** The query retrieved 48 amphetamine drug labels that included Physician Labeling Rule (PLR) and non-PLR formatting. Fourteen different versions of the OVERDOSAGE section were identified. Clinical manifestations were similar across the 14 labeling versions. However, five (36%) exclude serotonin syndrome. Three (21%) mention a dose range for toxicity and lethal dosage in rats, an old labeling practice no longer recommended. Management of toxicity varied; five (36%) mention treatment with phentolamine and chlorpromazine, of which four (29%) also mention medication treatment with barbiturates. Two (14%) labeling versions suggested gastric decontamination using activated charcoal. Five (36%) labeling versions recommend gastric lavage, which is no longer supported in treatment guidelines. The query identified two versions from three methamphetamine drug labeling. Manual analysis demonstrated that both versions had identical information for clinical manifestations and treatment (i.e., recommending a consultation with a Certified Poison Center without other interventions).
**Conclusions:** Natural language processing text-mining efficiently extracted the OVERDOSAGE sections of amphetamine and methamphetamine drug labeling. These analyses identified opportunities to revise and harmonize amphetamine and methamphetamine labeling for overdose management, particularly with regards to medication treatment interventions and gastrointestinal decontamination recommendations.

## 094. Trends in Pediatric Cocaine Exposure Reported to U.S. Poison Centers

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**Background:** Cocaine is a central nervous system stimulant responsible for inhibiting the reuptake of biogenic amines. Cocaine use causes euphoria, however, toxicity can be magnified in the pediatric population due to differences in physiology. Cocaine has been commonly studied in adults, although available literature in the pediatric population is scarce.
**Hypothesis:** The number of pediatric patients (ages 0-18) exposed to cocaine is increasing over time and affected pediatric patients may be at risk for cardiovascular and neurologic toxicity distinct from the adult population.
**Methods:** This is a retrospective review of data reported to the National Poison Data System database between 2012-2020. Incidence rates, trends in patient demographics, therapies used, subsequent outcomes, co-ingested substances and geographical distribution were analyzed. Subgroups consisting of two major exposure groups (zero to nine y/o & 10-18 y/o) were specifically analyzed.
**Results:** From 2012-2020, there were 3179 cases of pediatric cocaine exposure reported to U.S. Poison control centers. Incidence is increasing in all age groups, but rates in children ages zero to nine increased 44% overall while only 16% in the 10-18 year old group. There is no clear association between exposure and ICU/critical care admission, however younger children were more likely to be admitted for non-critical care ($p < 0.001$), while older children were more likely to be treated and released. Excitatory toxic effects were most commonly seen in all age groups. Depressive effect rates were similar amongst groups. Younger children were more likely to be exposed via the unintentional route. Older children had more intentional exposures.
**Conclusion:** Pediatric cocaine exposures have increased significantly. Our findings suggest younger and older children suffer similar effects from cocaine exposure, however routes of exposure and co-exposures differ. Rates of cocaine abuse among older children are also increasing over the same time period.

## 095. Levamisole: a Classic Adulterant with a Novel Association

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**Background:** Adulterants are agents added to illicit substances in the drug supply for various reasons-as mimics, synergistic high enhancers, or bulking agents. While classically found in cocaine, levamisole has been detected anecdotally in other substances during the opioid epidemic.
**Research Question:** What is the prevalence of levamisole detected in the serum of emergency department (ED) patients with confirmed illicit opioid overdose?
**Methods:** This is a subgroup analysis from the Toxicology Investigators Consortium (ToxIC) Fentalog Study, an ongoing multi-center study across the US. ED patients with suspected opioid overdose were included across eight sites from September 30, 2020 to October 1, 2022. Discarded serum from each patient was analyzed via liquid chromatography quadrupole time-of-flight mass spectroscopy to detect the qualitative prevalence of over 1,000 psychoactive substances and metabolites. Descriptive statistics (R vs. 4.1.2) were calculated for the prevalence of levamisole among confirmed cocaine overdose and confirmed opioid overdose.
**Results:** From September 30, 2021 to October 1, 2022, 537 samples were collected, of which levamisole was detected in 22.2% ($n = 119$). Additionally, levamisole was present in 60.3% ($n = 151$) of all cocaine-positive patients. The majority of levamisole was discovered in the northeast region of the US (62.2%) ($p = 0.01$). Levamisole was also present in patients without stimulants; it was detected in 5.8% ($N = 103$) of patients with fentanyl without stimulants. Levamisole was identified in the majority of patients (54.5%) with fentanyl, non-fentanyl opioids, and stimulants.

**Conclusion:** In this large multi-center subgroup analysis of ED patients with confirmed opioid overdose, levamisole prevalence was higher than expected. Levamisole may now be more commonly found in opioids, even in the absence of stimulants.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

**096. Psilocybin-Induced Wide Complex Bradycardia**

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**Background**: Psilocybin-containing magic mushrooms are used worldwide for their hallucinogenic properties. Typically, patients with psilocybin toxicity present with visual hallucinations, tachycardia, mydriasis, and anxiety due to the drug's sympathetic effects. In this case report, a young man presents with syncope and wide complex bradycardia after ingestion of psilocybin-containing mushrooms.
**Case Report:** An 18-year-old otherwise healthy presented to the emergency department with syncope after ingestion of magic mushrooms. Per family, the patient became nauseous and collapsed with a reported 30-second unresponsive episode. He was initially fatigued but well-appearing and without complaint. Vital signs were HR 45, BP 135/84, T 36.7. Physical exam was otherwise unremarkable. Comprehensive drug screen was positive for caffeine, nicotine, and psilocybin. Electrocardiogram showed bradycardia and a wide complex QRS with T-wave inversions. The patient was admitted for cardiac monitoring and further workup, where he remained bradycardic on telemetry without recurrent QRS widening. The patient returned to baseline the following day and was discharged with ZIO monitoring.
**Discussion**: Cardiotoxic effects of psilocybin in otherwise healthy patients have been identified including Wolff-Parkinson-White syndrome, arrhythmias, myocardial infarction, and Takotsubo cardiomyopathy. The mechanisms of cardiovascular toxicity are complex. Active metabolites present in psilocybin are known to interact with adrenergic, dopaminergic, and serotonergic pathways. Wide complex bradycardia as an effect of psilocybin has not been previously reported.
**Conclusions**: This is an atypical presentation of psilocybin toxicity in an 18-year-old male after ingestion of magic mushrooms. The patient presented with bradycardia, mild hypertension, and a wide-complex QRS that resolved without intervention. Supportive care is the standard of treatment.

**097. Patterns of Lysergic Acid Diethylamide (LSD) Exposures Reported to the U.S. Poison Centers**

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**Objectives:** According to the Centers for Disease Control and Prevention, there were more than 107,000 overdose deaths in the United States (U.S.) in 2021. Lysergic acid diethylamide (LSD) is a commonly misused drug, with over 28 million people in the U.S. having used LSD in their lifetime. This study sought to evaluate recent trends in LSD exposures reported to the U.S. poison centers (PCs).
**Methods:** NPDS was queried for LSD exposures from 2011 to 2021. We descriptively assessed demographic and clinical characteristics. Poisson regression models were used to evaluate trends in the number and rates (per 100,000 human exposures) of LSD exposures.
**Results:** There were 9,385 LSD exposures reported to PCs during the study period. Among these, 74.4% cases were reported from acute care hospitals and 80.2% were single substance exposures. Ages 20 to 29 years (28.9%) constituted the most common age group. Males accounted for 73.6% of cases. Most exposures occurred in a residence. Ingestion (78%) was the most common route of exposure. The most frequently reported co-exposure was marijuana (11.1%). Intentional abuse (75.3%) and suspected suicides (10.2%) were the most common reasons for exposure. Approximately 17.5% of the cases were admitted to a critical care unit; 5.4% were admitted to a psychiatric facility. Major effects were seen in 7.5% of cases and moderate effects were reported in 52.5% of cases. Tachycardia, agitation, and hallucinations were the commonly encountered clinical effects. Intravenous fluids and benzodiazepines were the most frequently used therapies. The frequency of LSD exposures increased by 156.2% (95% CI: 143.4%, 168.4%, $p < 0.001$) while the rate increased by 163.2% (95% CI: 152.2%, 175.8%, $p < 0.001$).
**Conclusions:** The number of LSD exposure cases handled by PCs increased significantly over the study time period, highlighting a concerning growing trend. A significant number of cases were admitted to a critical unit.

**098. Recent Trends in U.S. Poison Center Data Involving E-cigarettes and Liquid Nicotine Products**

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**Background:** E-cigarettes and liquid nicotine (ECLN) products contain high concentrations of nicotine. Use of ECLN products has increased over the last decade in the United States (U.S.).
**Research Question:** Examine characteristics and trends of ECLN exposures reported to Poison Center (PCs).
**Methods:** The National Poison Data System (NPDS) was queried for ECLN exposures from 2011 to 2021. We identified and assessed relevant demographic and clinical characteristics. Poisson regression models were used to evaluate trends in the number and rates (per 100,000) of ECLN exposures.
**Results:** There were 34,890 ECLN exposures reported during the study period, of which 93.9% were single substance exposures. Reports from acute care hospitals comprised 15.6% of cases. Children under 6 years (64.9%) constituted the most common age group. Exposures among teenagers (13 – 19 years) significantly decreased during the last three years of the study period. Males accounted for 54.1% of cases. Most exposures occurred in a residence. Ingestion was the most common route of exposure. The most frequently co-occurring substances were alcohol (0.6%) and marijuana (0.5%). Unintentional reasons (general) (70.5%) and intentional misuse (8.7%) were the most common reasons for exposure. Of the total cases, 24% were treated and released from the emergency department and 2.2% were admitted to a critical care unit. Major effects were seen in 1.1% of cases. The majority of cases had minor or no clinical effects; however, 33 deaths occurred in the study sample. Vomiting and cough/choking were the most common clinical effects. The frequency and rate of ECLN exposures increased by approximately 76% and 91%, respectively.
**Conclusions:** The number of ECLN exposures increased over the study period. These products can be a health risk, especially among young children. Child resistant packaging and increased public awareness could be key measures to address this public health issue.

### 099. Bursting Presumptions: Chloroethane "Popper" Induced Cardiac Arrest and Hyperkalemia

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**Background:** "Poppers" encompass a variety of psychoactive xenobiotics utilized for recreation and sexual enhancement. Although traditionally associated with alkyl nitrites, "poppers" can refer to other inhalants, which may have distinctly different toxicities.
**Methods:** This is a single patient case in an academic hospital network.
**Results:** A 59-year-old healthy man was found pulseless and cyanotic with three empty "popper" bottles. The patient received prehospital endotracheal intubation and cardiopulmonary resuscitation for one hour. In the ED, spontaneous circulation (ROSC) was achieved after administration of three grams of IV calcium chloride. His post-ROSC ECG showed a new right bundle branch block and peaked T waves, which were consistent with his metabolic acidosis (pH <6.93) and hyperkalemia (potassium, 6.9 mEq/L). Because of reported "popper" use, he was treated empirically with 0.5 mg/kg methylene blue, without clinical improvement. His post treatment methemoglobin concentration was 0.8%. His brain CT was suggestive of anoxic brain injury. Despite transfer to a tertiary care hospital and aggressive supportive care, he expired. Forensic investigation revealed that the patient's "popper" was a chloroethane-containing solvent sold as video head cleaner. Waste blood from the initial presentation sent for forensic analysis showed a chloroethane concentration was 3.1 mcg/mL. Citalopram and cannabinoids were also detected, but alkyl nitrites were not detected. The cause of death was determined to be "toxic effects of chloroethane and citalopram."
**Conclusion:** Highlighting the diversity of inhalationals, the "popper" in this case was a chloroethane solvent and not an alkyl nitrite. Inhalation of chloroethane can cause dizziness, euphoria, hallucinations, CNS depression, and fatal arrhythmia leading to "sudden sniffing death." Patients unaware of this distinction may suffer unanticipated toxicity. Pre-hospital and emergency providers should also be aware of this diversity in order to pursue an appropriately broad differential in critically ill patients after reported "popper" use.

### 100. Bone-Tired: Difluoroethane Inhalant Dependence Causing Diffuse Skeletal Fluorosis

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**Background:** Skeletal fluorosis, characterized by disruption of the bone architecture due to fluoride accumulation, is typically caused by chronic exposure to fluoride-contaminated groundwater in developing countries. Skeletal fluorosis is less commonly caused by recreational inhalation of computer cleaners containing difluoroethane. We describe a case of skeletal fluorosis found incidentally in a patient presenting after a traumatic injury.

**Methods/Results:** This is a single-patient chart review. A 26-year-old-man with a history of inhalant abuse presented to the Emergency Department (ED) for evaluation of injuries sustained in an assault. He reported daily inhalation of 10-15 containers of a difluoroethane-containing computer cleaner for the past 1.5 years. He also reported severe anxiety and insomnia upon cessation of use, as well as chronic diffuse achy bone pain. Imaging showed prominent sclerosis and cortical expansion of the visualized axial and appendicular skeleton, not present on previous imaging from 3 years before. Laboratory analysis revealed an alkaline phosphatase of 1504 U/L, with normal liver function. Urine fluoride levels were elevated at 16.88 mg/L (normal range 0.2-3.2 mg/L). Nuclear medicine bone imaging showed diffusely increased uptake, greatest in the lower extremities. He was also noted to have low vitamin D levels at 14 ng/mL and elevated parathyroid hormone levels at 131 pg/mL. In consultation with Endocrinology, the patient was started on 4000 IU daily of cholecalciferol and ultimately transferred to a rehabilitation center for his substance abuse.
**Conclusion:** The patient's lab results, and dramatic x-ray findings were consistent with skeletal fluorosis from chronic inhalation of difluoroethane-containing computer cleaner. This diagnosis should be suspected in patients with marked alkaline phosphatase elevations and/or cortical thickening on x-ray. Cessation of use and high-dose cholecalciferol are mainstays of treatment.

### 101. Kratom-Induced Acute Cholestatic Liver Injury: a Case Report

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**Background**: Recreational use of *Mitragyna speciosa*, also known as kratom, has recently skyrocketed in the United States prompting public concern regarding its possible adverse effects. Despite its growing popularity, only a small collection exists in the literature detailing kratom-induced hepatotoxicity.
**Hypothesis**: Kratom is a rare cause of acute cholestatic liver injury.
**Methods**: This is a case report of a single patient who developed cholestatic-pattern liver injury after using kratom.
**Results**: A 54-year-old male developed progressive nausea and jaundice after ingesting a homemade tea brewed with kratom powder purchased at a smoke shop several times over several weeks. He denied any exposure to hepatotoxic agents. Exam on arrival was noteworthy for jaundice and scleral icterus but otherwise normal. Labs on admission included total bilirubin 10.8 mg/dL, direct bilirubin 6.2 mg/dL, AST 305 IU/L, ALT 466 IU/L, and alkaline phosphatase 861 IU/L. Acetaminophen was undetectable. He began intravenous N-acetylcysteine (NAC) per acetaminophen protocol at admission. He had one small gallstone but MRCP was negative. His viral and autoimmune hepatitis panels and CA-19-9 were negative. His total bilirubin peaked at 13.5 mg/dL, AST at 370 IU/L, ALT 619 IU/L, and alkaline phosphatase at 1085 IU/L, notably at different times during his four-day hospitalization. He continued NAC at 6.25 mg/kg/hr for a total of three days after his initial two protocol infusions. The patient was discharged home due to his stability and minimal symptoms with plans for outpatient labs and possible liver biopsy if he failed to show more improvement, as well as elective cholecystectomy. Unfortunately, he was lost to follow-up.
**Conclusion**: Kratom was the most likely cause of acute liver injury in this patient. NAC had no adverse effect but did not dramatically improve the patient during his four-day hospital stay.

### 102. Prolonged Symptoms Including Posterior Reversible Encephalopathy Syndrome Followed by Delayed Hypotension After Extended-Release Guanfacine Overdose

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**Background:** An initial short hypertensive period followed by hypotension is typical for alpha-2 agonist toxicity. Severe sequelae including posterior reversible encephalopathy syndrome (PRES) and prolonged delayed hypotension are not commonly reported after guanfacine overdose.
**Methods:** A 16-year-old female ingested 90-120 pills of 3 mg guanfacine ER and 5 pills of 25 mg aripiprazole. In the emergency department, she was drowsy with a heart rate of 50 beats per minute (bpm) and blood pressure (BP) of 117/84 mmHg. During the 24-hours post ingestion, she became more somnolent with brief apneic episodes and progressive hypertension up to 171/89 mmHg while remaining bradycardic (nadir 35 bpm). Approximately 30-hours post ingestion, she had a tonic-clonic seizure which self-terminated spontaneously. MRI prior to seizure demonstrated a hyperintense signal in the parietal lobe, with a faint frontal lobe and subcortical white matter intensity. She received a nicardipine drip (0.5-1.0 mcg/kg/min) for PRES approximately 48-hours after ingestion and continued intermittently for 26-hours. Symptomatic hypotension (systolic BP < 100 mmHg) developed 96-hours after ingestion and was

responsive to fluids. BP nadir was 58/23 mmHg at 109-hours post ingestion with a near syncopal episode. Bradycardia remained in the 50s bpm with orthostatic hypotension until hospital day 7 at which point all guanfacine toxicity resolved. The patient was discharged to behavioral health without neurological sequelae.
**Results:** Guanfacine serum concentrations 7-hours after ingestion was 40 ng/mL (reference 2.1 – 3.7 ng/mL), 72-hour post ingestion demonstrated peak guanfacine levels of 160 ng/mL and 96-hour post ingestion level was 98 ng/mL. Aripiprazole level drawn 4-hours after ingestion was 41 ng/mL (reference 5 mg steady state 70 – 126 ng/mL).
**Conclusion:** We present a single case of intentional guanfacine ER overdose resulting in hypertensive emergency with PRES and seizures followed by prolonged symptomatic bradycardia and hypotension. Supporting confirmatory testing is shared.

### 103. "Everything but the Kitchen Sink (And Toilet)!" Severe Withdrawal from the Designer Benzodiazepine Bromazolam Requiring Complicated Pharmacological Treatment

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**Background:** Designer benzodiazepines (DBZD) are becoming increasingly prevalent in recreational drug markets. There is limited pharmacological data available on DBZDs but generally have varying degrees of potency and are GABA-A receptor agonists like traditional BZDs. We describe a patient with severe withdrawal after use of the DBZD bromazolam.
**Methods:** Single patient chart review. 29-year-old male with polysubstance dependence including opioids and BZDs presented to the ED with a laceration to his buttocks after he fell onto a toilet while searching for his "stash" in ceiling tiles. He was initially discharged after repair but had progression of delirium. His significant other called police after he attempted to strangle her while in transit back to the hospital. Symptoms started after cessation of a new dark web supply of BZDs and progressed despite initial treatments with haloperidol, midazolam, and lorazepam. Finally, phenobarbital five mg/kg and methadone were administered intravenously, and he transiently calmed. He was admitted to the ICU for suspected BZD withdrawal.
**Results:** The patient received aggressive pharmacological support including BZDs, phenobarbital, antipsychotics, and sympatholytics, and by day three, symptoms improved (phenobarbital 130 mg/4 hours, dexmedetomidine 1.5 mcg/kg/hour, valproic acid 500 mg twice/day, methadone 110 mg/daily, quetiapine 400 mg/night and an alprazolam taper). While he reported using "flualprazolam" obtained from the "dark web," his significant other provided pills. Forensic analysis confirmed bromazolam at approximately 3 mg/tablet. Synthesized bromazolam has become increasingly identified as counterfeit alprazolam. His course was complicated by waxing/waning delirium and aggression. On day nine, off phenobarbital and dexmedetomidine, despite ongoing tapering of alprazolam, he left against medical advice after he was determined to have capacity.
**Conclusion:** Withdrawal from DBZDs is not well understood and may be complicated due to severe dependence from easy availability and use of DBZDs with unknown pharmacology.

### 104. Negative Urine Drug Screens Leading to Diagnostic Momentum Bias, a Call to Arms for Improved Provider Education

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**Background:** Immunoassay urine drug screens (UDS) are often employed to evaluate for drug exposures. Typically, providers order a "standard drug screen" which evaluates for 5-6 classes of drugs. These UDS panels have poor specificity and sensitivity for many of the recreational drugs used today. Nevertheless, there remains an overreliance on the UDS by healthcare providers.
**Hypothesis:** Diagnostic biases due to misinterpretation of the UDS can be deadly.
**Methods:** This single-patient chart review involves a previously healthy toddler who, despite two admissions for naloxone-responsive apnea, died of acute fentanyl toxicity.
**Results:** On two separate occasions over two months, this patient presented to the Emergency Department apneic and unresponsive. Both times they were treated successfully with naloxone and admitted. During the first hospitalization, a UDS, lumbar puncture, and brain MRI were unremarkable. An electroencephalogram revealed generalized delta slowing with intermittent sharp activity, deemed possibly related to seizures. Given the recurrence of symptoms leading to the second hospitalization and second negative UDS, levetiracetam was initiated for presumed seizures. Despite the providers' discovery of parental arrest for fentanyl possession shortly prior to the second admission, the patient was

again discharged into the parents' care. The patient was seen by neurology two weeks after the second admission and levetiracetam continued. Five days later, they were found unresponsive by their mother and, after prolonged resuscitation for asystole, died in the emergency department. Postmortem serum fentanyl concentration was 14 ng/ml.
**Conclusion:** The negative drug screens were used by providers when concluding this patient's symptoms were most likely related to a seizure disorder, despite clinical evidence suggesting opioid toxicity. Ironically, conscious efforts to avoid diagnostic momentum bias led to just that. This case serves as a critical reminder of the work needed to improve provider understanding of the nuances and limitations of drug testing.

## 105. Urine Drug Testing In The Pediatric Population: Retiring the Legacy Drug Testing

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**Background:** The frequency of drug exposures in the pediatric population continues to rise. New capabilities of testing with liquid chromatography-mass spectrometry (LC-MS) detect a wider range of drugs compared to the older immunoassay.
**Methods:** This two-part study had a retrospective and a prospective arm involving pediatric patients. First, a retrospective chart review collected data over a four-year period on patients who had both an in-house immunoassay and an LC-MS urine drug test. The second arm employed an expanded mass chromatography test that detected over 90 drugs. Urine samples initially sent for immunoassay testing were further tested using the expanded urine drug test.
**Results:** Data was collected from 125 patients in the retrospective am and 126 patients in the prospective arm that met inclusion criteria. Thirty-two percent of immunoassays in the retrospective arm were positive compared to fifty percent of LC-MS tests being positive. Statistical analysis with Chi Squared Test found a statistically significant difference in detection of drugs with the LC-MS screen with a $p$-value of 0.003 ($p < 0.05$). Comparatively, the prospective arm showed forty-eight percent of immunoassays were positive versus seventy-one percent positivity with LC-MS. Findings of the prospective data were calculated to have a statistically significant difference for detection of drugs with LC-MS versus immunoassay testing using the Chi Squared Test with a $p$-value of 0.0003 ($p < 0.05$).
**Conclusion:** While testing often does not alter initial management of patients, it could add knowledge regarding peak onset, half-life, levels of drug exposures, as well as epidemiological information. LC-MS testing is a broader, more sensitive and specific option for drug testing in pediatrics.

## 106. Implementation of a Real-Time Urine Immunoassay for Fentanyl Detection at a Children's Hospital

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**Background:** Children are tragic victims of the opioid epidemic and fentanyl has predominated since 2013. Our 2019 survey noted <30% of our region's hospitals could test for fentanyl in real-time.
**Research Question:** What is the performance of a urine fentanyl immunoassay (ARK™ Fentanyl II assay on Vitros™ 4600 analyzer) implemented by our tertiary-care children's hospital on September 14th, 2021?
**Methods:** Positive fentanyl immunoassays, reflexively confirmed via liquid chromatography / tandem mass spectrometry, were identified retrospectively for six months after implementation. Charts were abstracted into a de-identified database by a single investigator as a quality assurance process; subsequent review was considered exempt from human subjects' protection.
**Results:** 1401 immunoassays happened over 6 months; 53 (3.8%) positive for fentanyl. Confirmatory testing on 51 samples (50 patients) found one (2%) false positive result judged due to ciprofloxacin cross-reactivity. Age range of 49 patients with confirmed true positive tests was 1 day to 25 years (median 4 years). Thirty-nine (80%) were administered medical fentanyl prior to urine collection; none of these patients had fentanyl poisoning as diagnosis at discharge. Among 10 victims not given medical fentanyl prior to urine collection, the age range was 19 days to 18 years (6 ages 0-5; 1 age 6-11; 3 ages 12-18). Three of 10 (30%) fentanyl poisoned children were hospitalized in an ICU; one child (age 12 years) died of fentanyl poisoning.
**Conclusion:** Our hospital detected six fentanyl poisonings among children less than six years in six months and identified one death. This assay performed well in our population with a false positive rate of ~2%. We cannot determine a false negative rate as confirmatory testing is not performed on negative tests. This assay may perform differently in different laboratory and clinical environments. During a fentanyl poisoning epidemic, a reliable test for timely detection in children appears valuable.

## 107. Fentanyl Co-Positivity on Urine Drug Immunoassay with Amphetamines, Cocaine, Benzodiazepines, and Opioids: a Single Site, Academic Urban Hospital Experience

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**Background:** Unintentional exposure to fentanyl and fentanyl analogs have contributed to an exponential increase in drug related overdose deaths in recent years.
**Research Question:** What is the prevalence of concomitant positivity for fentanyl in patients with positive urine immunoassay screening panel (UISP) for other substances of abuse at a single urban academic hospital in Boston?
**Methods:** We reviewed all UISPs collected between June and October 2022 as part of routine clinical care in all clinical settings. The UISP consists of the following substances: fentanyl/norfentanyl (homogeneous enzyme immunoassay (HEIA), 3.5 ng/mL and 5 ng/mL cutoff, respectively), amphetamines (kinetic interaction of microparticles in solution (KIMS), 1000 ng/mL), cocaine metabolite (KIMS, 150 ng/mL), benzodiazepines (KIMS, 100 ng/mL), opiates (KIMS, 300 ng/mL), and oxycodone (HEIA, 100 ng/mL). Descriptive statistics were performed to describe the proportions of concomitant positive findings for fentanyl on the UISP.
**Results:** Of the 4935 urine samples reviewed, 56.5% (388/687) of cocaine-positive samples, 36.0% (250/694) of benzodiazepine-positive samples, 34.7% (173/499) of amphetamine-positive samples, 29.7% (79/266) of opiate-positive samples, and 23.4% (76/325) of oxycodone-positive samples were co-positive for fentanyl. A total of 781 samples were positive for fentanyl. Of these, 78.0% (608/781) have at least one or more other substances detected.
**Conclusion:** Significant concomitant fentanyl/norfentanyl was detected with all other substances on our UISP, suggesting alarming fentanyl co-exposure within our patient population. Particularly notable is co-positivity with stimulants, with more than half of the cocaine samples and over one third of the amphetamine samples detected with fentanyl. Limitations of this study include unclear iatrogenic exposure to fentanyl and unknown motives for substance use among the population. These results offer insight to the phenomenon of unintentional exposure to fentanyl adulterants among individuals who use both opioid and non-opioid substances, especially stimulants.

## 108. Using an Expanded Lexicon to Identify Bias, Stigma and Discrimination Experiences Related to Medications for Opioid Use Disorder in Social Media Communities

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**Background:** Patients receiving MOUD (Medications for Opioid Use Disorder) frequently report stigmatization by the recovery community, the media and healthcare workers, and discuss these experiences on social media forums.
**Research Question:** Can social media data be used to develop an expanded lexicon of terms related to MOUD patient experiences of stigma?
**Methods:** This was a descriptive, convenient sample of Reddit community posts containing stigma-related words over ten years. We created a lexicon of semantically similar words and spelling variants associated with MOUD-related stigma and identified patient descriptions of stigmatization within Reddit communities. The original lexicon was compiled from literature on stigmatizing language for people with OUD. We then identified words with high semantic similarity or close spelling variations of the original list via word embeddings models trained on drug-use related social media chatter. Each round of lexicon word embeddings expansions was complemented by clinical expert annotation to evaluate and filter results. We used the lexicon to search four MOUD-related Subreddits, described frequencies of matched posts, and randomly sampled 10 posts per word to assess relevance to experiences of stigma.
**Results:** Our initial 13-word lexicon expanded to 88 words. We identified 21,035 posts and comments containing words in our lexicon, out of 172,375 (12.2%), written by 12,039 (54.5%) of the 22,082 subscribers between 2012 and 2022. Qualitative annotation identified posts containing words semantically similar to or close misspellings of: “stereotype” (100%), “stigma” (100%), “abuser”(90%), “junkie” (80%), and “addict” (70%) as most consistently describing patient-reported stigmatization experiences.
**Conclusion:** Social media data is a rich source for stigma-related information reported by patients with OUD. This lexicon can be a resource to improve identification and evaluation of MOUD-patient experiences of stigma in online formats, or other sources such as online hospital reviews or EHR data.

### 109. Olanzapine/Samidorphan Precipitated Opioid Withdrawal in a Patient Taking Buprenorphine

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**Background:** Olanzapine/Samidorphan (Lybalvi®) is a novel oral agent approved by the FDA for the treatment of schizophrenia and bipolar I disorder in June 2021. It was designed to reduce weight gain associated with olanzapine. Samidorphan is 3-carboxamido-4-hydroxy analog of naltrexone, initially intended to treat substance use disorders, antagonizing mu-, delta- and kappa- opioid receptors. This is thought to be the primary mechanism in preventing weight gain through complex interactions involving insulin, opioid, and endocannabinoid messaging systems.
**Methods:** This is a single patient chart review. A 36-year-old female took her first dose of olanzapine/samidorphan shortly before calling for emergency services. EMS reported involuntary muscle movements felt to be due to dystonia from olanzapine. Patient had taken diphenhydramine and an epinephrine auto injector but continued to have symptoms. In the ED, she was experiencing generalized muscle spasms lasting for several seconds and diaphoresis. Initial vital signs were SPO2 of 98% on room air, HR 73 bpm, BP 186/78 mmHg. Initial electrocardiogram revealed QRS 106 and QTc 436.
**Results:** Initially, the patient was thought to be having a dystonic reaction to the olanzapine. She was given diphenhydramine 25 mg IV, diazepam 2mg IV, and benztropine 1 mg IV. It was later determined that the patient took 16 mg of buprenorphine SL daily. With this information, precipitated opioid withdrawal was the likely cause of this event. The patient received 16 mg of buprenorphine for an initial COWS score of 11 with repeat COWS of 6. We recommended avoiding olanzapine/samidorphan and continuing taking home buprenorphine.
**Conclusion:** Initiating olanzapine/samidorphan in the setting of chronic buprenorphine treatment can result in precipitated opioid withdrawal.

### 110. Well, It's One Louder, Isn't It? The Answer to Buprenorphine Precipitated Withdrawal? More Buprenorphine

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**Background:** Buprenorphine is a partial opioid agonist that is FDA-approved for treatment of opioid use disorder. Its high affinity and potency allow it to displace full opioid agonist from the μ-opioid receptor, causing precipitated withdrawal. Possible risk factors for acute precipitated withdrawal include fentanyl or methadone use. Clinical experience suggests high-dose buprenorphine "rescue" therapy is safe and efficacious but there is little literature to support this practice.
**Methods:** We present two cases of buprenorphine precipitated withdrawal managed in the emergency department with high doses of buprenorphine.
**Results:** Case one: A 52-year-old man presented in precipitated withdrawal after taking his own 8 mg sublingual (SL) buprenorphine preparation, after a month of daily fentanyl use, without first allowing for a period of withdrawal. He received a total of 32 mg buprenorphine SL, 3 mg oral lorazepam, and 4 mg oral ondansetron over 90 minutes with resolution of symptoms and was discharged from the ED. Case two: A 36-year-old man, previously on methadone 95 mg daily, presented for precipitated withdrawal after taking buprenorphine 8 mg SL within 48 hours of methadone use. He received 40 mg buprenorphine SL, diazepam 5 mg IV, and diazepam 5 mg oral over a two-hour period with rapid improvement. He experienced recurrence of withdrawal symptoms eight hours later, requiring an additional two doses of buprenorphine 16 mg SL. He was discharged the next day on buprenorphine 8 mg twice daily.
**Conclusion:** High-dose buprenorphine safely helps manage buprenorphine-precipitated withdrawal without respiratory depression.

### 111. Acute Fentanyl Overdose in Pediatric Chronic Opioid Users with Subsequent Buprenorphine Induction and Maintenance Therapy

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**Background:** Pediatric opioid abuse and its sequelae remain poorly described in the literature compared to adult opioid use. Data pertaining to use of buprenorphine in pediatric patients is similarly sparse. Here we describe two cases of teenage males presenting after acute opioid overdose that were subsequently treated with buprenorphine for opioid withdrawal and were maintained on buprenorphine therapy after discharge.

**Methods:** This is a retrospective chart review. Case 1: A 17-year-old male presented in cardiac arrest after opioid overdose. Urine testing obtained on admission was positive for fentanyl and cannabinoids. He was extubated on hospital day 2 and conveyed that he thought he had obtained and ingested Percocet. He started on buprenorphine microinduction, 300 mcg IV every six hours doubled every 24 hours until transitioned to 8mg SL BID. He was discharged successfully on suboxone. Case 2: A 17-year-old male presented in ARDS, shock, after utilizing cocaine, fentanyl. Urine testing on admission was positive for cocaine, fentanyl, cannabinoids. Following extubation he developed symptoms consistent with opioid withdrawal with a COWS score of ten. He was started on Suboxone 8 mg daily, increased to 8 mg twice daily with adequate control of withdrawal symptoms, which was maintained throughout his hospitalization. He was discharged successfully on suboxone.
**Discussion:** These two cases are representative of a rising trend in teenage opioid exposures, and of the utility of buprenorphine therapy for acute treatment of opioid withdrawal and long-term use for opioid use disorder in these patients. Given its safe and effective use in adults, buprenorphine maintenance therapy offers potential for treatment of teenagers with opioid use disorder and merits further study.
**Conclusion:** Overdose on recreational opioids, namely fentanyl, is an underappreciated etiology in pediatric patients as is opioid use disorder. Buprenorphine is a safe, effective treatment for opioid use disorder in pediatric patients.

## 112. Successful Buprenorphine-Naloxone Induction After Buprenorphine Transdermal Patch in Severe Loperamide Toxicity Requiring Transvenous Pacing

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**Background**: Loperamide is an over the counter antidiarrheal that can cause mu-receptor agonism at supratherapeutic doses, often misused to treat opioid use disorder (OUD). Complications of high dose loperamide ingestion include QTc prolongation and Torsades de pointes (TdP) due to interaction with the IKr (hERG) channel. Buprenorphine is a safer option for management of OUD without further QTc interval prolongation.
**Hypothesis**: Transdermal buprenorphine can aid buprenorphine-naloxone induction following resolution of life-threatening loperamide toxicity.
**Methods**: This is a single patient case study via chart review. A 40-year-old man with a history of opioid use disorder that presented with syncope in the setting of chronic loperamide ingestion; he reported taking 48-84 tablets of 2 mg Loperamide daily over the past several months
**Results**: The patient was found to have significantly prolonged QTc to 697 ms along with multiple episodes of ventricular tachycardia requiring defibrillation. He received several doses of magnesium and ultimately received overdrive pacing via transvenous pacemaker. On day 1 of admission, the patient was initiated on a 40 mcg/hr transdermal buprenorphine patch before sublingual induction with 2 mg-0.5 mg buprenorphine-naloxone every 2 hours for 4 doses on hospital day 3. Ultimately, he was continued on a dose of 8 mg-2 mg buprenorphine-naloxone twice daily on hospital day 4. Upon review of prescription fill data, the patient has been compliant with this medication as he has been consistently filling it since discharge.
**Conclusion**: Transdermal buprenorphine with transition to buprenorphine-naloxone can be used for successful induction and management of opioid withdrawal in a case of chronic loperamide toxicity. This regimen is also preferred over methadone in order to prevent any further QTc prolongation or ventricular dysrhythmia in the setting of loperamide toxicity.

## 113. Variability in Inpatient Buprenorphine Induction Prescribing Patterns Among Medical Toxicology Fellowship Program Faculty

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**Background:** Buprenorphine is increasingly common in the inpatient setting both as medication-assisted therapy for opioid use disorder (OUD) and for treatment of opioid withdrawal. Though inpatient buprenorphine induction decreases rates of leaving the hospital against medical advice and 30-day readmissions, there are no current major society guidelines for inpatient buprenorphine induction. Hypothesis: Academic toxicology faculty exhibit a wide range of prescribing behavior for common buprenorphine induction scenarios.
**Methods:** This survey included 12 multiple-choice questions relating to buprenorphine prescribing patterns. It was disseminated to all US Medical Toxicology fellowship program directors by email in October 2022, with a request to forward to all board-eligible or board-certified Toxicology/Addiction Medicine faculty. Analysis was descriptive. Data collection is ongoing; preliminary results are presented here.
**Results:** Of 23 completed surveys, 14 (60.9%) respondents were board-eligible or board-certified for both Toxicology/

Addiction Medicine. Sixteen (70.0%) respondents initiated a patient on buprenorphine at least four times in the previous month. For typical inductions, the most common starting doses were eight mg (30.4%), two mg (26.1%), and 0.5mg (21.7%). For patients already on full agonist opioid therapy, 47.8% would not initiate buprenorphine, while 34.8% would begin a microinduction protocol and 17.4% would wait until opioid requirements decrease. In a patient with buprenorphine-precipitated withdrawal, 15 (65.2%) would give additional buprenorphine while three (13.0%) would give full agonist therapy; six (26.1%) responded "other."
**Conclusion:** In a sample of academic Toxicology faculty, dosing and strategy towards inpatient buprenorphine induction varies widely. Nearly 50% of respondents indicated that they would not start buprenorphine in a patient on full agonist opioid therapy, though abundant literature suggests it is both safe and effective in this scenario. More research is needed into outcomes associated with different prescribing approaches to optimize care for this vulnerable population.

### 114. Changes in Route of Administration Among People Who Use Fentanyl, ToxIC Core Registry, 2014-2021

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**Background:** The drug overdose crisis and illicit drug supply continue to evolve, as have behaviors of people who use drugs. A better understanding of changing drug use behaviors, including routes of administration (ROA), allows for more tailored prevention and response activities.
**Methods:** We analyzed data from the Toxicology Investigators Consortium (ToxIC) Core Registry from 2014-2021. We explored changes in reported ROA among medical toxicology patient consultations with an intentional exposure to fentanyl. Annual counts and percentages by ROA were calculated.
**Results:** Annual counts of intentional fentanyl exposures with ROA reported were similar from 2014 ($n = 27$) to 2015 ($n = 29$), rising slightly in 2016 ($n = 41$) before increasing in 2017 ($n = 72$). Counts were similar from 2017 to 2018 (82), increasing in 2019 ($n = 134$) and dipping slightly in 2020 (n = 118) before increasing again in 2021 ($n = 201$). Annual dermal exposures (i.e., patch) dropped from 44.4% in 2014 ($n = 12$) to 1.0% in 2021 ($n = 2$). Annual injection exposures increased from 3.7% in 2014 ($n = 1$) to 19.5% in 2016 ($n = 8$) before dropping in 2017 ($n = 4$;5.6%), peaking at 32.8% in 2019 ($n = 44$), and decreasing to 9.0% in 2021 ($n = 18$). Smoking exposures first occurred in 2016 ($n = 3$;7.3%) increasing in 2020 ($n = 20$; 16.9%) and peaking at 19.9% in 2021 ($n = 40$). Annual snorting exposures increased from 2014 ($n = 1$;3.7%) through 2019 ($n = 15$;11.2%), peaking at 20.3% in 2020 ($n = 24$) and dipping in 2021 ($n = 34$; 16.9%). Annual oral exposures rose from 14.8% ($n = 4$) in 2014 to 34.5% ($n = 10$) in 2015, and after a low in 2019 ($n = 19$; 14.2%), rose to 21.2% in 2020 ($n = 25$) and 21.4% in 2021 ($n = 43$).
**Conclusion:** Results show shifting drug use behaviors initially from transdermal use to injecting, then to smoking or snorting. The need for harm reduction strategies for people who smoke, snort, or inject drugs, as well as other evidence-based prevention and accessible treatment remains urgent in combating the overdose crisis.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 115. Risk and Protective Factors for Concomitant Benzodiazepine Misuse Among Opioid Misusers: an Analysis of NSDUH Data From 2015-2019

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**Background:** Rarely lethal in isolated ingestion, benzodiazepines show an increasing degree of morbidity and mortality associated with overdose when co-ingested with opioids. Several studies have evaluated these trends and identified a limited number of associated risk and protective factors surrounding the concomitant misuse of benzodiazepines and opioids. Of those studies that used national data, most focused on the consequences of benzodiazepine and opioid co-ingestion rather than risk factors associated with their misuse. Consequently, we aim to elucidate risk factors associated with benzodiazepine co-ingestion with opioids on a wider scale.
**Methods:** This was a retrospective review of National Survey on Drug Use and Health (NSDUH) data collected from 2015-2019. We analyzed the characteristics of the population that reported opioid and benzodiazepine misuse, conducted a trend analysis, and then conducted a binomial logistic regression to determine what factors were best predictors of co-use. Data was summarized with descriptive statistics where appropriate.
**Results:** Between 2015-2019, 3,366 survey participants, which is representative of 2,463,497 people in the general population, reported misusing benzodiazepines concurrently with opioids. There was no increase in misuse overtime ($p$

= 0.36), with 24.2% of opioid users reporting misuse with benzodiazepines in 2015 and 22.0% in 2019. Characteristics positively associated with concomitant misuse included being employed $p < 0.049$), whether they sold illegal drugs ( $p = 0.003$), and whether they ever misused tranquilizers including benzodiazepines (aOR = 59.6, $p < 0.001$). Characteristics negatively associated with misuse of benzodiazepines and opioids together included age ($p < 0.001$), recent pain reliever use ($p = 0.003$), and whether they ever misused sedatives ($p < 0.001$).

**Conclusion:** The study identifies potential risk and protective factors for benzodiazepine and opioid concomitant misuse. Future studies to further investigate these findings are needed to help implement targeted interventions for risk reduction in this population.

### 116. Prevalence of Laboratory Confirmed Hallucinogens within an Emergency Department-Derived Opioid Overdose Cohort

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**Background:** Hallucinogen and illicit dissociative drug use remains a public health concern due to the potential for altered behavior; psychological dependence; and, toxic or delayed mental health effects, often related to the adulteration or complete chemical misrepresentation of the drug to the user. Recent social media discussions around 'microdosing' and other forms of unregulated, self-medication for wellness or therapeutic use, highlights the continuing need to identify changing use patterns within the population.

**Research Question:** What is the prevalence of exposure to hallucinogens among a group of adult emergency department (ED) patients presenting with a suspected opioid overdose?

**Methods:** This study utilizes data from a prospective, ongoing multicenter consecutive cohort of ED patients aged 18+ with suspected opioid overdose presenting at eight US sites within the Toxicology Investigators Consortium Fentalog Study. Cases with complete clinical and analyte data (waste blood analysis via liquid chromatography quadrupole time-of-flight mass spectrometry) through September 2022 were included.

**Results:** Of the 537 eligible patients, 8.9% ($n = 48$) tested positive for one or more hallucinogens/illicit dissociative drugs. PCP analogues represented most cases (75.0%, $n = 36$). Ten cases (20.8%) lacked any opioid analytes; all were PCP+. Identified dissociative and hallucinogenic stimulants included MDMA ($n = 3$), mCPP ($n = 6$), and ketamine ($n = 2$). Common analytes in the opioid negative cases included synthetic cannabinoid (MDMB-4en-PINACA), adulterants (phenacetin, levamisole), natural cannabinoids, and methamphetamine. Among opioid positive samples, 89.5% case samples ($n = 34$) indicated fentanyl/fentanyl analogues. Common prescription opioids were methadone (42.1%, $n = 16$) and tramadol (15.8%, $n = 6$). At least one dose of naloxone was administered to both the opioid negative (80%) and positive (88%) patients ($p = NS$).

**Conclusion:** Under one-tenth of patients presenting to the ED with a suspected opioid overdose tested positive for hallucinogenic/dissociative drugs, with the prevalence of actual opioid positive cases reported in one-half of this patient subset.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 117. The Prevalence of Novel Psychoactive Substances in Opioid Overdose Patients

Kim Aldy[1,2], Paul Wax[1], Rachel E Culbreth[1], Alex Krotulski[3], Jeffrey Brent[4], Sharan Campleman[1], Barry Logan[3,5], Alison Meyn[1], Shao Li[1], Stephanie Abston[1], Alexandra Amaducci[6], Bryan Judge[7], Michael Levine[8], Joshua Shulman[9], Adrienne Hughes[10], Evan Schwarz[11], Alex F Manini[12], On Behalf of the Toxicology Investigators Consortium (ToxIC) Fentalog Study Group

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**Background**: Novel Psychoactive Substance (NPS) use has been increasing in the U.S.; however, more research is needed to identify epidemiological patterns of their use, particularly among opioid overdose patients.
**Research Question**: What is the prevalence of NPS in suspected opioid overdose patients presenting to the emergency department (ED)?
**Methods**: The Toxicology Investigators Consortium Fentalog study is an ongoing prospective multicenter cohort of eight U.S. medical centers. Adults with suspected opioid overdose who present to the ED were included. Qualitative toxicological analyses were performed on blood samples using liquid chromatography quadrupole time-of-flight mass spectrometry for the presence of over 900 psychoactive substances.
**Results**: Among the total sample ($n$ = 537), 170 cases (31.7%) tested positively for at least one NPS. 113 cases (21.0%) had at least one NPS opioid, 51 (9.5%) had at least one NPS benzodiazepine, and 2 (0.3%) had at least one NPS stimulant. Twelve cases (2.2%) tested positively for NPS alkaloids (2.2%), 2.8% tested positively for NPS cannabinoids, and 1 tested positively for a dissociative NPS (deschloroketamine). Among those with confirmed opioid overdoses ($n$ = 493), only one case had an NPS opioid in isolation. Other combinations included 11.4% with fentanyl and an NPS opioid, and 6.7% with fentanyl, an NPS opioid, and a prescription opioid. Three percent of cases had a combination of all four types of opioids: NPS, fentanyl, prescription opioid, and non-fentanyl opioid. The majority (64.3%) of fentanyl and NPS opioid cases ($n$ = 56) also included stimulants. Three percent of cases had both NPS opioids and NPS benzodiazepines.
**Conclusion**: Approximately one-third of patients presenting to the ED with an apparent opioid overdose were found to have additionally taken an NPS. NPS opioids were commonly found alongside fentanyl, prescription opioids, stimulants, and benzodiazepines.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 118. Access to, Experience with, and Attitudes Towards Take-Home Naloxone: an Online Survey of Drug Users

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**Background:** The opioid public health crisis continues to burden individuals, communities, and economies. Public health opinion has emphasized the need for more access to harm reduction services, but there is a dearth of information on the views and experiences of opioid users on harm reduction and naloxone use. Our study aimed to investigate the prevalence of naloxone use, attitudes, and experiences with naloxone among a worldwide online community of drug enthusiasts. Furthermore, to assess accessibility of harm reduction services for these communities.
**Methods:** We performed a cross-sectional survey of drug enthusiasts looking at their experiences with and attitudes towards take-home naloxone. Attitudes towards harm reduction programs were also evaluated. The survey was composed of 56 questions.
**Results:** A history of recreational opioid use was reported in 55.9% of the respondents. Prescription opioid pills was the most common opioid of choice among respondents (51.9%, $n$ = 317). Only 38% of opioid users had received naloxone training ($p$ <.001), but 56% of opioid users said that they felt comfortable and understood how to use a naloxone kit. Nearly all respondents (95%) said they would be willing to use naloxone on someone who had overdosed. In terms of harm reduction access, 24% of responders said they had access to safe use or safe injection programs, and 33% said they had access to clean needle exchange programs.
**Conclusion:** A significant majority of the opioid user population were in favor of having naloxone with them when using drugs and believed naloxone should be freely available to people. This is encouraging for implementing take home naloxone (THN) programs within opioid using communities and demonstrates the receptiveness of users to having naloxone with them. Further, this study highlights the need for more outreach, education, and accessible information on where to find safe use and injection spaces or programs.

### 119. Heroin or Fentanyl: Prevalence of Confirmed Fentanyl in ED Patients with Suspected Heroin Overdose

Siri Shastry[1], Kim Aldy[2,3], Jeffrey Brent[4], Paul Wax[2,5], Alex Krotulski[6], Barry Logan[6,7], Sharan Campleman[2], Rachel Culbreth[2], Alex Manini[1], On Behalf of the Toxicology Investigators Consortium (ToxIC) Fentalog Study Group
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**Background:** United States (US) drug overdose deaths are at a record high with over 70,000 opioid overdose deaths in 2021. This staggering increase is due to the increasing prevalence of fentanyl in the US drug supply. It is unclear whether patients with opioid overdose are knowingly using fentanyl or believe they are using heroin while unknowingly using fentanyl. We aimed to examine the prevalence of confirmed fentanyl in emergency department (ED) patients with self-reported heroin overdose.
**Hypothesis:** We hypothesized that the proportion of fentanyl in presumed heroin overdoses would be higher than that of confirmed heroin biomarkers.
**Methods:** This is a subgroup analysis from a prospective multicenter consecutive cohort of ED patients aged 18+ with opioid overdose presenting to 9 US Toxicology Investigators Consortium (ToxIC) sites from 2020 to 2021. Patient waste blood was sent for analysis using liquid chromatography quadrupole time-of-flight mass spectrometry. De-identified toxicology results were paired with the clinical database for analysis. Reported heroin use was based on chart review. The primary outcome was the proportion of patients who reported heroin use and the confirmed opioid analytes.
**Results:** Of 1006 patients screened, 406 were eligible. Of 168 patients who reported taking heroin, 88% ($n = 147$) were in fact found to have fentanyl or a fentanyl analog present on serum analysis ($p < 0.0001$). In contrast, only 46 (27%) had heroin biomarkers present.
**Conclusion:** The prevalence of confirmed fentanyl in ED patients with suspected heroin overdose was extremely high, while the prevalence of heroin was very low with significant discordance between the opioids patients believed they used versus actual opioids identified. US clinicians should presume that fentanyl is involved in all illicit opioid overdoses and should counsel patients on harm reduction measures. This has implications for duration of ED observation, naloxone dosing and buprenorphine induction, requiring further study.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 120. Rise in Opioid Insufflation and Inhalation Reported to a Statewide Poison Center, 2016-2020

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**Background:** Opioid and fentanyl-related overdoses continue to rise in the United States. Deaths attributed to synthetic opioids, mostly fentanyl, topped 35,000 in 2019. As the crisis continues, characterizing trends related to opioid and fentanyl use remains important to identify opportunities for prevention and intervention.
**Hypothesis:** Reported cases of fentanyl inhalation will increase over time.
**Methods:** A large, single state Poison Center database was queried for all intentional inhalation exposures between 2016 and 2020 that presented to a healthcare facility. Inclusion criteria included exposure by any inhalational route, including smoking, vaping, and insufflation, and recorded AAPCC outcomes of major effects or death. Exclusion criteria included multiple and/or unknown substance exposures and non-inhalation routes of exposure. Patients with reported opioid exposure were then analyzed separately.
**Results:** One hundred eighty four cases were initially identified. Thirty one were excluded because of miscoding, unknown exposure, or polysubstance involvement. Of the remaining 153 cases, 94 (61.4%) involved opiate or opioid use. Annual reported fentanyl inhalation increased from two cases in 2016 to five in 2017 to 33 cases in 2020. Similarly, reported insufflation of prescription opioid medication such as oxycodone also increased from zero cases in 2016 to 17 in 2020. Heroin insufflation cases peaked at four cases in 2018 and none were reported in 2020. Fentanyl accounted for 55 (58.5%) of the total number of exposures. No deaths were reported.
**Conclusion:** Though limited by sample size, this analysis suggests that significant poisonings involving inhalation use of opioids, especially fentanyl, is increasing yearly. Further research is needed to better characterize the patterns of opioid inhalation and enact public health measures to address these changes.

## 121. Geographical Differences in Opioid, Stimulant, and Benzodiazepine Use Among Suspected Opioid Overdoses Presenting to the Emergency Department

Rachel E Culbreth[1], Kim Aldy[1,2], Paul Wax[1], Alex Krotulski[3], Jeffrey Brent[4], Sharan Campleman[1], Barry Logan[3,5], Shao Li[1], Alison Meyn[1], Stephanie Abston[1], Alexandra Amaducci[6], Bryan Judge[7], Michael Levine[8], Joshua Shulman[9], Adrienne Hughes[10], Evan Schwarz[11], Alex F Manini[12], On Behalf of the Toxicology Investigators Consortium (ToxIC) Fentalog Study Group
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**Background:** While previous research has examined geographical differences in opioid use, little is known about the regional differences in combinations of opioids, stimulants, and benzodiazepines among patients presenting to the emergency department for suspected opioid overdose.
**Research Hypothesis:** The combination of opioids and stimulants is more prominent in the West compared to the Northeast and Midwest.
**Methods:** This cohort is from the Toxicology Investigators Consortium (ToxIC) Fentalog Study Group, an ongoing multicenter study across the United States. Consecutive emergency department patients with suspected opioid overdose were included across 8 sites from September 21, 2020 and October 1, 2022. Sites included the Northeast (New York, Pittsburgh, Newark, and Bethlehem), the Midwest (Grand Rapids and St. Louis), and the West (Portland and Los Angeles). Discarded serum from each patient was analyzed via liquid chromatography quadrupole time-of-flight mass spectroscopy to detect psychoactive substances and their metabolites. Chi-square tests were utilized to detect differences between analytes and geographical regions.
**Results:** The percentage of any opioid detected among suspected opioid overdose patients was 91.8% overall ($N = 537$), and there were no differences in the prevalence of any opioid between regions. However, higher percentages of opioid and stimulant combinations were detected in the Midwest (61.7%) and the West (59.3%) compared to the Northeast (41.5%) ($p < 0.001$). Additionally, combinations of opioids and benzodiazepines were highest in the West (35.6%) compared to the Northeast (32.2%) and Midwest (20.4%) ($p = 0.01$). The combination of all three substances (opioids, stimulants, and benzodiazepines) was nearly twice as high in the West (27.1%) compared to the Northeast (15.1%) and the Midwest (12.6%) ($p = 0.03$).
**Conclusion:** Combinations of opioids and stimulants were more prominent in the West compared to the Northeast and Midwest in a study among suspected opioid overdoses. This study demonstrates that ongoing public health surveillance is needed to identify regional emerging drug trends.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 122. Trends and Predictors of Emergency Department Clinician Opioid Utilization for Acute Pain in Opioid Use Disorder: a Survey Study

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**Background:** While some guidelines advocate providing short-acting opioids for pain in opioid-use disorder (OUD) patients, no studies have evaluated emergency department (ED) factors affecting clinical decision-making for pain management in OUD.
**Study Question:** How frequently would OUD patients treated for acute pain in the ED (one) receive opioids at initial evaluation and (two) receive opioid prescriptions at discharge? What clinician factors are associated with opioid administration or discharge prescribing for an OUD patient?
**Methods:** A 31-question survey was distributed to a convenience sample of 536 EM clinicians in an urban, academic medical system. For two hypothetical cases (cellulitis, fracture), clinicians answered questions about pain medication type, dosing administration, and reason for selection at three time points.
**Results:** The 79 respondents (14.7%) were male (53.2%), white (63.3%) and had practiced EM for nine years. For OUD patients with cellulitis, respondents initially provided acetaminophen (75.9%), ketorolac (48.1%), and morphine (13.9%). 34.8% indicated that "history of OUD" was most important in their decision to not initially provide opioids while 39.1% described other factors. For OUD patients with fracture, respondents initially provided morphine (39.2%) or ketorolac (38.0%). 40.3% provided opioid prescriptions at discharge. 57.1% described "history of OUD" as most important in their decision not to initially treat with an opioid. For cellulitis and fracture, clinician male gender was associated with increased odds of prescribing opioids at initial (7.4 and 5.2, respectively) and repeat evaluations (4.9). For fracture, opioid treatment at initial evaluation was associated with increased odds of opioid discharge prescription (7.1, 95% CI 1.2-41.4).
**Conclusion:** For OUD patients, opioid prescribing frequency at initial ED treatment varied by clinical scenario, and less than half of clinicians prescribed opioids at discharge. Male gender was a positive predictor of opioid treatment, and initial opioid treatment was a positive predictor of opioid prescription at discharge.

## 123. Xylazine Detection in Forensic Blood Samples and Comparison of Clinical and Postmortem Concentrations

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**Background:** Xylazine, an alpha-2 receptor agonist used in veterinary medicine for its sedative and muscle relaxant effects, is now seeing widespread positivity as a result of its use as an adulterant in illicit opioids, known as "Tranq Dope". Xylazine has been designated a toxic adulterating substance, due to its causation of hypotension and bradycardia, CNS and respiratory depression, and the development of skin lesions in chronic intravenous drug users. We compare concentrations of xylazine in fatalities and compare those to concentrations in living subjects in impaired driving cases to provide context for the interpretation of xylazine in clinical or forensic casework.
**Methods:** The prevalence and concentrations of xylazine in 2.5-years of driving-under-the-influence-of-drugs (DUID) and medicolegal-death-investigation (MDI) cases (January 2019-June 2021) was investigated. Of over 170,000 cases screened for xylazine during this time frame, 97% were classified as MDI.
**Results:** Quantitative xylazine results were reported for 3,215 of 3,691 cases which screened positive. Overall, 2.8% of DUID, and 2.1% of MDI cases screened positive for xylazine with almost complete overlap in concentrations of 5.1-450 ng/mL (mean= 36 ng/mL) and 5.0-11,000 ng/mL (mean= 41 ng/mL), respectively. Two MDI cases which had xylazine concentrations of 9,100 and 11,000 ng/mL were drug overdose suicides that did not involve any opioids. Opioids, primarily fentanyl and/or a fentanyl byproduct/metabolite were detected in 100% of xylazine positive DUID cases, and all but two MDI cases.
**Conclusion:** Xylazine exposure in opioid drug users continued to increase during the study period, with most exposure resulting from the adulteration of illicit opioids. Assessment of xylazine content of street drug samples, and typical drug use patterns together with inferences from animal studies, and these blood drug concentrations, suggests that contributions to intoxication from typical amounts of use may be clinically relevant, but are unlikely to be independently lethal.

## 124. Implementation of Urine Xylazine Testing by GC-MS in Patients with Substance Use: Experience from a Multicenter Hospital System

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**Background:** Xylazine, an $\alpha_2$-agonist used medically as a veterinary tranquilizer, is increasingly combined with fentanyl. Standardized protocols for detecting and treating xylazine intoxication are not well-established. Our laboratory implemented a qualitative gas chromatography-mass spectrometry (GC-MS) test to detect xylazine in urine. We report the initial results to help guide standardized testing and conduct a feasibility study of xylazine detection by liquid chromatography-tandem MS (LC-MS/MS), which could provide quantitative results with greater sensitivity.
**Hypothesis or Research Question:** What were the patient characteristics and rates of urine drug testing co-positivity among patients who were ordered a GC-MS urine test for xylazine?
**Methods:** We conducted a retrospective chart review of all patients who had a urine xylazine test ordered by the treating clinician. We extracted patient demographics and drug screens from electronic health records (EHR Epic) via the Clarity database.
**Results:** Sixty-three urine xylazine tests were performed between January and October 2022, of which 36 (58%) revealed xylazine. We obtained clinical data for 40 patients. The average age was 45, 70% were men, and 60% were white. Of samples that tested positive for xylazine, 18/20

(90%) were also positive for fentanyl or metabolites. Other drugs detected in those with xylazine present were cocaine (2/20, 10%), methamphetamine (2/20, 10%), benzodiazepines (6/20, 30%) and methadone or other opiates (4/20, 20%).

**Conclusions:** These findings are consistent with a high prevalence of xylazine co-exposure in patients who use fentanyl. Xylazine testing in patients with fentanyl use could be utilized to characterize the fentanyl-xylazine intoxication, overdose, and withdrawal syndromes in comparison to fentanyl alone. Serial quantitative xylazine levels by LC-MS/MS could be valuable to define the duration of detection and interpret the significance of the presence or absence of xylazine when considering suspected overdose or withdrawal.

### 125. testRI: Xylazine Detection Rates in Local Drug Supply Testing

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**Background:** The drug supply is volatile and rapidly changing, thus increasing health risk among people who use drugs (PWUD). Xylazine, an alpha-2 agonist, commonly used in veterinary medicine as a sedative, was recently detected across unregulated drug supplies in the United States.

**Hypothesis or Research Question:** What is the incidence of xylazine adulteration across types of drug samples in local drug supply testing?

**Methods:** Through collaboration with community outreach partners, we obtained and tested 76 donated drug samples from May to September 2022. Samples tested included product, baggies, and used equipment (e.g., cookers, cottons). All testing was conducted at the Rhode Island Hospital Toxicology Laboratory via LC-QTOF-MS comprehensive toxicology screen. Results were rapidly disseminated via multiple mediums through collaboration with the Rhode Island Department of Health (RIDOH) and community partners.

**Results:** Xylazine was found in 53% ($n = 40$) of samples tested. The 76 samples were sold as: fentanyl (53%), crack (17%), cocaine (8%), Percocet (8%), dope (i.e., illicit opioids) with fentanyl (5%), crystal methamphetamine (5%), heroin (1.3%), carfentanil (1.3%), and unknown (1.3%). Xylazine was found in samples sold as: Percocet (100%), dope with fentanyl (75%), fentanyl (65%), crystal methamphetamine (50%), and crack cocaine (8%). Xylazine was also found in the samples sold as carfentanil and "unknown." Xylazine was not detected in the samples sold as heroin or any powder cocaine. All xylazine results were encountered in samples that also contained fentanyl.

**Conclusion:** Xylazine was found in over half of drug samples tested to date in our study. Advanced local drug supply testing including active cuts (i.e., xylazine) is essential to track new concerning substances within the supply to guide local harm reduction approaches and inform medical management of complications of a changing drug supply.

### 126. An Analysis of Triggers and Therapies Described in Reddit Posts of Cannabinoid Hyperemesis Syndrome

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**Background:** Despite the increasing reports of cannabinoid hyperemesis syndrome (CHS), knowledge remains limited about the patient experience including symptom triggers and treatments outside of the acute care setting. There is an active online community on the social network Reddit of approximately 11,200 members dedicated to the discussion of "Cannabinoid Hyperemesis Syndrome."

**Research Question:** What are the symptom triggers and therapies reported by individuals with CHS on Reddit?

**Methods:** We collected data from six subreddits and applied natural language processing (NLP) methods to target posts referencing CHS (e.g., by searching lexical variants). Based on a manual review of these posts, two experts identified a set of common themes. Two commonly described themes were triggers and therapeutic strategies for CHS exacerbations. Utilizing NLP, we identified posts that mentioned content related to these themes, and we quantified their occurrences in a sample.

**Results:** The sample consisted of 448 trigger-related and 664 therapy-related posts. CHS triggers most commonly mentioned: food and drink (62), cannabinoids (45), mental health (e.g., stress, anxiety) (27), alcohol (22), consumption behaviors (e.g., vaping) (12). Most frequently mentioned therapies: hot water/bathing (62), hydration (60), antiemetics (42), food and drink (38), gastrointestinal medications (38),

mindfulness (e.g., meditation, yoga) (35), capsaicin (29), probiotics (26), dopamine antagonists (18). Food and drink categories in both trigger and treatment-related posts were broad and no clear patterns were identified. Mental health and alcohol were prevalent triggers mentioned within posts but are not frequently identified in the literature. While many of the therapies mentioned have been well documented, behavioral responses such as meditation and yoga have not been explored by the medical community.
**Conclusion:** Reddit subscribers frequently discuss well-known triggers and therapies, but also mention themes that are rarely captured in the medical literature. Further objective studies in patients with CHS are needed to corroborate these findings.

### 127. Atrioventricular Blockade in Adolescent Acute Cannabis Exposure

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**Background:** Cardiovascular effects such as atrioventricular (AV) blockade, bradycardia, orthostasis, and syncope have been reported rarely in chronic cannabis users. There are no reports of AV blockade or bradycardia in pediatric patients, nor any involving a single acute exposure.
**Hypothesis**: A single acute exposure to cannabis can be associated with transient bradycardia and AV blocks in pediatric patients without preexisting cardiac disease.
**Methods:** This is a case report of a 15-year-old female with no previous medical history and no family history of cardiac disease who experienced evolving cardiotoxicity after ingesting an edible at school that "smelled like weed". Data were obtained from chart review and the authors' clinical evaluation. 11 electrocardiogram (EKG) images were obtained from the Epiphany Cardio Server™.
**Results:** The patient presented to a tertiary care academic pediatric emergency department with euphoria, nausea, vomiting, and depressed mental status. She denied previous use of cannabinoids. Her initial EKG showed sinus rhythm with a first-degree AV block. Seven hours post ingestion, her EKG progressed to Mobitz II AV block. She was evaluated by the medical toxicology service and was subsequently admitted to the children's hospital on telemetry. There were no electrolyte derangements to explain her dysrhythmias. During her hospitalization her EKGs improved to Mobitz I, sinus bradycardia, and eventually sinus rhythm at 48 hours post ingestion. She did not experience any symptomatic bradycardia or require acute intervention for hemodynamic instability. Urine immunoassay drug screen collected approximately 10.5 hours post ingestion was presumptive positive for tetrahydrocannabinol (THC). Cannabinoids confirmation was positive with a carboxy-THC level of 141 ng/mg creatinine (cutoff < 20 ng/mg creatinine, Cannabinoids Mass Spectrometry Urine Reflex, MedTox Laboratories). No additional substances were detected on a 23-panel expanded toxicology screen (ToxAssure Flex 23™, MedTox Laboratories).
**Conclusion:** Cardiovascular toxicity may occur after acute cannabis use in patients without preexisting cardiovascular disease.

### 128. An Unusual Cause of Coma, Hypotension and Bradycardia: Cannabidiol (CBD) and Tetrahydrocannabinol (THC) Toxicity

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**Background:** As tetrahydrocannabinol (THC) and cannabidiol (CBD) use has become more common, so have adverse events. Large ingestions can demonstrate tachycardia, CNS excitation and sedation, and very rarely hypotension. Bradycardia has not been reported until this case.
**Methods:** This is a case report at a tertiary center with an inpatient toxicology service. THC, THC-OH, THC-COOH, CBD, CBN, CBG, and CBC were measured in the patient's initial serum using a Sciex QTRAP 6500+ mass spectrometer (ABSciex, Redwood City, CA).
**Results:** A 77 year old female, naive to opiates and THC/CBD, presented 1 hr after ingesting 10 gummies containing 100 mg THC and 100 mg CBD total for leg pain. On initial presentation she was somnolent, bradycardic (HR 55 bpm) and hypotensive (SBP 35-78 mm Hg). She had pinpoint pupils and was given 2 doses of naloxone 2 mg with minimal improvement after the first dose and no change after the second. Atropine 1 mg and epinephrine drip improved the HR and BP, and she was intubated for airway protection. She remained intubated and on norepinephrine until resolution of hypotension and coma the following morning. The following compounds were identified in her serum (all in ng/mL): THC 10.7, CBD 5.6, THC-OH 14.3, THC-COOH 292, CBN 0.29, CBG <0.25, and CBC 0.53.
**Conclusions:** Previously published levels from occasional marijuana smokers after smoking showed CBD levels of (0.6-5.4 ng/mL). Similarly, serum levels in occasional marijuana smokers after ingestion of THC infused products found THC levels (3.6-22.5 ng/mL). Although serum

concentrations are similar to occasional marijuana users, this patient's severe hemodynamic compromise may be due to a combination of the patient's naivety to these compounds, age and importantly, as CBD's adenosine receptor agonism.

### 129. Analytical and Clinical Implications of Emerging Cannabinoid Isomers

Ayako Chan-Hosokawa, Chelsey Deisher, Laura M Labay
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**Background:** The 2018 Farm Bill legalized industrial hemp production, making cannabis and cannabis derived products containing less than 0.3% delta-9 tetrahydrocannabinol (THC) more accessible. To respond to growing consumer interest, cannabis manufacturers have exploited legislative loopholes since the bill's introduction. As a result, commercial availability of edibles, dietary supplements, e-cigarettes, and other cannabis containing products has increased exponentially. These products could contain cannabinoid isomers (e.g., delta-8 THC), other cannabinoids (e.g., cannabidiol), and even synthetic cannabinoids.
**Methods:** A five-year retrospective review of cannabinoid positive cases between 2018 and 2022, reported from driving under the influence of drugs (DUID) investigations was conducted to determine prevalence and analytical impact of delta-8 THC.
**Results:** Of approximately 45,000 blood cannabinoid positive blood cases examined, the prevalence of delta-8 THC began to rapidly increase in 2020. It is predicted that delta-8 THC will account for at least 10% of the confirmed cannabinoid cases in 2022. This review also demonstrated that delta-8 and delta-9 THC are commonly detected together, highlighting the importance of isomer separation due to their differences in psychoactive potency and receptor binding affinities. Clinical symptoms between delta-9 THC from cannabis and hemp-derived delta-8 THC were similar; relaxed attitudes, tremors, elevated blood pressure and pulse, bloodshot and dilated eyes, lack of convergence, rebound dilation, and circular sway. One notable difference was the presence of horizontal gaze nystagmus (HGN) associated with delta-8 THC use. More research is needed to validate this finding.
**Conclusions:** Delta-8 THC and other cannabinoid isomers could be responsible for increased inconclusive test results if these isomers are not differentiated on chromatographic instruments. Samples with unconfirmed positive immunoassay screen results should be considered for further emerging cannabinoid isomer testing.

### 130. Risk and Protective Factors Surrounding Use of Marijuana During Last Alcohol Use: an Analysis using NSDUH data from 2015-2019

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**Background:** Cannabis and alcohol are two of the most commonly used substances individually, and together are among the most commonly co-used substances. The negative effects of alcohol and cannabis co-use have been investigated, and in limited populations, researchers have studied associated risk factors for co-use. Of those that have looked at risk factors for co-use, none have used national data. Consequently, we have undertaken this initiative to increase our understanding of associations surrounding cannabis and alcohol co-use on a wider scale.
**Methods:** This was a retrospective review of National Survey on Drug Use and Health (NSDUH) data collected from 2015-2019. We analyzed the characteristics of the population that reported using marijuana during their last alcohol use, conducted a trend analysis, and then conducted a binomial logistic regression to determine what factors were best predictors of co-use. Data was summarized with descriptive statistics where appropriate.
**Results:** Between 2015-2019, 13,254 respondents reported marijuana use during their last alcohol use, and there was an increasing trend over time ($p = 0.023$). Characteristics positively associated with co-use included first smoking before age 18 (aOR: 2.2, $p = 0.03$), sale of illegal drugs ($p < 0.001$), receiving a prescription medication or seeing a health professional for depressive feelings in past year (aOR: 12.4, $p = 0.026$), and levels of discouragement in the face of problems (aOR: 3.2, $p = 0.03$).
**Conclusion:** Our study found that there has been an increase in respondents that reported use of marijuana concomitantly with their last use of alcohol; we have identified preliminary risk factors based on NSDUH data for co-use. Policymakers and providers should consider the findings from this study when considering future investigation and potential interventions for alcohol and cannabis co-use risk reduction.

### 131. Seizure Mimics in Pediatric Cannabis Toxicity

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**Background:** Seizures are a rare complication of pediatric cannabis toxicity increasingly reported with widespread cannabis legalization. Occurrence may necessitate extensive workup and treatment, including antiepileptics, antibiotics, lumbar puncture, brain imaging, electroencephalography, neurology consultation, intubation, and critical care transport to tertiary care centers. Other poorly recognized cannabis-induced neuromuscular phenomena including myoclonic jerks may be conflated with seizure, resulting in unnecessary diagnostics and therapeutics with potential negative health and financial implications for patients and consumption of scarce pediatric tertiary care resources.
**Hypothesis:** Cannabis-induced non-epileptic neuromuscular phenomena may mimic seizure but be distinguished by historical and clinical findings.
**Methods:** This is a consecutive-patient case series. Retrospective chart review of patients evaluated for cannabis toxicity by the medical toxicology service at a tertiary pediatric hospital from 2003 - 2022 was conducted. Patients were 18 years of age or less, had positive confirmatory toxicology testing, and no co-ingestions. Exposure year, age, sex, route of exposure, weight-based tetrahydrocannabinol (THC) dose, and clinical findings including hyperreflexia, clonus, rigidity, myoclonic jerks, and seizure were recorded. Fisher's exact and chi-square descriptive statistics were performed.
**Results:** One hundred seven patients were identified, average age was 8.8 years, average weight-based THC dose was 6.6 mg/kg. Nineteen patients had myoclonic jerks with preserved responsiveness and no lateralizing findings such as gaze deviation. Four patients had hyperreflexia, two had clonus, two had muscular rigidity. Seven patients had seizures clinically diagnosed by a neurologist with lateralizing findings and unresponsiveness; no seizures were captured on EEG. Exposure year and route, age, sex, and THC dose were not significantly correlated with myoclonic jerks or seizure.
**Conclusion:** Non-epileptic neuromuscular phenomena including myoclonic jerks in pediatric cannabis exposure may mimic seizure, resulting in unneeded workup and interventions, but may be distinguished by historical and clinical findings.

## 132. Delta-8 THC Commercial Product Analysis

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**Background**: Delta-8 tetrahydrocannabinol (Δ-8 THC) is a psychoactive cannabinoid and structural isomer of delta-9 THC. Recreational use of unregulated Δ-8 THC products has seen an alarming spike following the United States Agriculture Improvement Act of 2018, which inadvertently categorized them as hemp products.
**Research Question(s)**: (1) Provide a descriptive analysis of commercially sold Δ-8 THC packaging and (2) compare advertised Δ-8 THC content to independent analysis of commercial products.
**Methods**: Study authors purchased twenty Δ-8 THC products from retail stores in the Pittsburgh area. Samples were analyzed using established methods to determine cannabinoid content. Descriptive statistics were calculated for all variables. Pearson's correlation was calculated for Δ-8 THC content listed on packaging compared to Δ-8 THC content found on analysis. Mean differences among subgroups of interest (chocolate bars, tincture, vape liquid, gummies) were analyzed. Differences in continuous normally distributed variables with equal variance were compared using ANOVA: those with skewed distributions were compared with Wilcoxon Ranks Sum or Kruskal–Wallis tests.
**Results**: Presence of Δ-8 THC was detected in 19 of 20 products. A weakly positive correlation ($r = 0.38$) was found between advertised Δ-8 THC quantity and our analysis. The average variance in Δ-8 THC quantity was 313.8 mg, with a standard deviation of 416 mg. Factors associated with a decreased variance included (1) solid matrix (chocolate, gummies) and (2) absence of "lab tested" claim on its packaging.
**Conclusion**: Our findings suggest a positive correlation between Δ-8 THC product labels and the presence of Δ-8 THC on laboratory analysis. Solid matrices (i.e., chocolate and gummies) may have more accurate Δ-8 THC quantity labeling. Future studies with larger sample sizes would offer more conclusive data for this increasingly popular and potentially toxic compound.

## 133. Severe Outcomes Following Pediatric Cannabis Intoxications: a Prospective Cohort Study of an International Toxicology Surveillance Registry

Neta Cohen,[1,2] Mathew Mathew,[1,2] Jeffrey Brent,[3] Paul Wax,[4] Adrienne Davis,[1,2] Cherie Obilom,[4] Michele M. Burns,[5] Joshua Canning,[6] Kevin Baumgartner,[7] Yaron Finkelstein[1,2,8] on Behalf of the Toxicology Investigators Consortium Pediatric Cannabis Study Group

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**Background:** An increasing number of states have legalized recreational cannabis for adult use. Question: What are the risk factors of severe outcomes, including intensive care unit (ICU) admission or in-hospital death, in children who present to the emergency department (ED) with cannabis intoxication?

**Methods:** In this prospective cohort study we collected data on all pediatric patients (0–18 years) who presented with cannabis intoxication from August 2017 through June 2020 to the Eds of participating sites in the Toxicology Investigators Consortium (ToxIC), a multi-center registry of poisoned patients who receive a bedside consultation by medical toxicology services. In cases which involved polysubstance exposure, patients were included only if cannabis was a significant contributing agent. We collected relevant demographic, clinical, management, disposition, and outcome data. We conducted a multivariable logistic regression analysis to explore predictors of severe outcome. The primary outcome was a composite severe outcome endpoint, defined as ICU admission or in-hospital death. Covariates included relevant sociodemographic and exposure characteristics.

**Results:** One hundred and thirty-eight pediatric patients presented to a participating ED with cannabis intoxication and comprise the study cohort. There were 75 males (54%), median age was 14.0 years (IQR 3.7-16.0). Among 138 patients, 52 (38%) were admitted to ICU and/or died ($n < 5$) during hospital stay. In the multivariable logistic regression analysis, polysubstance ingestion (adjusted odds ratio [aOR] = 10.5, 95% CI: 3.2-34.3; $P < 0.001$) and cannabis edibles ingestion (aOR = 4.1, 95% CI: 1.6-10.7; $P = 0.003$) were strong independent predictors of severe outcome.

**Conclusion**: Pediatric patients that presented to ED with cannabis intoxication and had polysubstance intoxication or have ingested cannabis edibles had 10.5- and 4.1- higher odds of severe outcomes, respectively, than those without these characteristics. Prevention efforts should target these risk factors to mitigate poor outcomes in intoxicated children.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 134. Whole Blood THC-COOH as an Indicator of Daily Cannabis Smoking

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**Background:** Individuals with frequent cannabis consumption accumulate blood 11-nor-9-carboxy Δ9-tetrahydrocannabinol (THC-COOH), an inactive metabolite of the highly lipophilic parent drug THC. Daily cannabis users, who may have acquired pharmacodynamic tolerance to the acute psychomotor and neurocognitive effects of cannabis, would be expected to display an elevation in blood THC-COOH well in excess of levels displayed by occasional users.

**Research Question:** What cut-off blood concentration of THC-COOH distinguishes daily cannabis users from occasional users with optimal specificity and accuracy?

**Methods:** The study population ($n = 92$), who participated in a larger study of the PD/PK of cannabis, included daily cannabis smokers ($n = 52$), and occasional cannabis smokers ($\geq$ 2 days/month and $\leq$ 3 days/week; $n = 40$). Whole blood THC-COOH was measured after $\geq$ 8 hours of abstinence from all cannabis products (baseline concentration), and 30 minutes after the initiation of a 15 minute interval of ad libitum inhalation of smoked cannabis flower or concentrate (post-use).

**Results:** Occasional user baseline THC-COOH (median, min, IQR, max) : 0, 0, 0 – 1.2, 13.1 ng/mL. Daily user baseline: 34.6, 2.9, 16.5 – 69.7, 180.5 ng/mL. Occasional user post-use THC-COOH: 6.1, 0, 3.1-10.7, 46.0 ng/mL. Daily user post-use: 56.5, 7.7, 29.7-113.4, 341.7 ng/mL. In receiver operating characteristic curve analysis that combined all baseline and post use values ($n$ =184 observations), a cut-point of blood THC-COOH = 16.3 ng/mL yielded optimal 95.0 % specificity, 82.7% sensitivity, 88.0 % accuracy, (Youden's J index = 0.78; Likelihood ratio + = 16.5) for identification of a daily cannabis smoker.

**Conclusion:** In a population that included occasional and daily cannabis smokers, a whole blood THC-COOH ≥ 16.3 ng/mL identified those with daily use with high specificity and good accuracy.

### 135. Compounding Interest: Systemic Toxicity from Topical Application of a Compounded Cream

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**Background:** Compounding combines xenobiotics into a proprietary medication that can address the complex medical needs of a patient. Creams/ointments are a common route of delivery. The xenobiotics, concentration, route, and the inactive ingredients in these creams are at the discretion of the prescriber. There are fewer regulations for compounded medications and they can present in overdose with unique toxicities.
**Methods:** This is a single case report. A 41 year old man with a history of chronic low back pain was found with altered mental status and bizarre behavior in a bank. On EMS arrival, the patient was somnolent and averbal. Naloxone (2 mg) was given with some improvement in alertness. Vital signs were significant for initial hypotension of 85/61, but otherwise within normal limits. On the physical exam, the patient was drowsy, answering questions with difficulty. His pupils were 1 mm and minimally reactive. Nystagmus was present and he was ataxic with impaired finger-to-nose testing and too unsteady to ambulate.
**Results:** The patient admitted to recently applying a compounded cream which was prescribed to him for low back pain. He applied it to his back and scrotum "in order to relax." The compounded cream contained ketamine 1%, gabapentin 6%, imipramine 3%, nifedipine 2%, bupivacaine 1% and clonidine 0.2% by weight. The patient had just picked up a 300 g container (a month's supply) and applied approximately half of it to his body. He received intravenous fluids with normalization of his blood pressure. The patient was admitted to the hospital for persistent altered mental status and ataxia and was discharged the next day when asymptomatic.
**Conclusion:** Compounded creams can contain unusual combinations of medications and may be used for recreational purposes. When applied to non-keratinized epithelium such as the genitalia, the risk of systemic toxicity is greatly increased.

## Day 3: Lightning Orals, Abstracts 136-142

### 136. Poison Center Utilization by Law Enforcement and Correctional Facilities: Single Center Data 2003-2022

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**Background:** There is a paucity of data pertaining to law enforcement personnel or correctional facility staff interactions with poisonings.
**Research Question:** The objective of this study was to characterize a single poison center's (PC's) calls from law enforcement or correctional facilities over a 20 year period.
**Methods:** A PC database was queried for all human exposure and information calls from 2003 to 2022 where the caller was recorded as police/sheriff/law enforcement or correctional facility nurse and calls were characterized.
**Results:** Over a 20-year period, 895 calls records were identified (790 exposure and 105 information) with 317 (40%) calls managed on site without hospital transfer. Correctional facility nurses received 415 calls (386 exposures). Of 482 substances reported in exposures, 47% were pharmaceuticals and 53% non-pharmaceuticals. Acetaminophen ($n = 17$), antipsychotics ($n = 15$), benzodiazepine ($n = 12$) were the most frequently reported pharmaceuticals. Bleach ($n = 26$), cationic cleaning agent ($n = 20$), ethanol ($n = 14$), disinfectant ($n = 13$) and alkali ($n = 13$) were the most frequently cited non-pharmaceuticals. Intentional exposure was reported in 235 (suspected suicide $n = 87$; abuse n = 48, misuse $n = 65$). The most frequently abused substances were ethanol, cocaine, amphetamine/methamphetamine, and benzodiazepines. Of 190 substances involved in suspected suicide attempts, 67% were pharmaceuticals. Law enforcement personnel received 480 calls (404 exposures). Of 639 substances reported in exposures, 77% were pharmaceuticals and 33% non-pharmaceuticals. Benzodiazepines ($n = 78$), opioids ($n = 30$), and SSRI ($n = 29$) were the most frequently reported pharmaceutical substances. Ethanol ($n = 105$; 71%) was the most frequently cited non-pharmaceutical substance. Intentional exposure was reported in 307 (suspected suicide $n = 188$; intentional abuse $n = 122$). The majority of exposures occurred in a residence ($n = 428$).
**Conclusions:** In this sample, the substances and exposure types encountered by law enforcement and correctional facility nurses are diverse. Of associated PC exposure calls, 40% were managed on-site without hospital transfer, indicating that PCs contribute to healthcare cost-reduction.

### 137. Yearly Trends and Regional Patterns of Novel Psychoactive Substances in Opioid Overdose Patients

Paul Wax[1], Rachel E Culbreth[1], Jeffrey Brent[2], Kim Aldy[1,3], Alex Krotulski[4], Sharan Campleman[1], Barry Logan[4,5], Stephanie Abston[1], Alexandra Amaducci[6], Bryan Judge[7], Michael Levine[8], Joshua Shulman[9], Adrienne Hughes[10], Evan Schwarz[11], Shao Li[1], Alison Meyn[1], Alex F Manini[12], On Behalf of the Toxicology Investigators Consortium (ToxIC) Fentalog Study Group[12]

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**Background**: Novel psychoactive substances (NPS) use trends continue to evolve yearly and regionally.
**Research Question**: What are the temporal trends and regional characteristics of NPS among suspected opioid overdose patients presenting to the emergency department?
**Methods**: The Toxicology Investigators Consortium Fentalog Study is a prospective multicenter cohort of suspected opioid overdoses among eight medical centers across the U.S. Blood from these patients underwent qualitative toxicological analyses using liquid chromatography quadrupole time-of-flight mass spectrometry for the presence of over 900 psychoactive substances. NPS yearly trends and regional patterns were compared using Chi-square tests and Fisher's exact tests.
**Results**: Among the total cases ($n = 537$), 170 cases (31.7%) tested positive for $\geq 1$ NPS. NPS opioids increased > 500% from 4.8% of all opioids in 2020 to 25.5% of all opioids in 2021. In 2022, NPS opioids comprised 20.5% of all opioids. These differences in NPS opioids by year were significant ($p < 0.001$). The highest percentage of NPS opioids among all opioids was in the Midwest (28.7%), followed by the Northeast (18.0%) and West (15.3%) ($p = 0.01$). NPS benzodiazepines comprised 1/3 of all benzodiazepines in 2020 (32.3%) and 2021 (35.2%) before decreasing to 16.0% in 2022 ($p =$ NS). The West had the highest percentage of NPS benzodiazepines (18.6%) among all benzodiazepines ($p = 0.04$). The majority (93.3%) of NPS cannabinoids ($n = 15$) were found in the Northeast ($p = 0.02$).
**Conclusion**: In this large multicenter cohort with NPS serum confirmation, NPS opioids have surged dramatically over the past 2 years. NPS opioids were highest in the Midwest, NPS benzodiazepines were highest in the West, and NPS cannabinoids were highest in the Northeast.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 138. Young Adults with Acute Opioid Overdose: What Substances Are Actually Involved?

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**Background:** Opioid overdose deaths doubled in young adults in the U.S. from 2015-2020, but the current xenobiotics/adulterants and clinical outcomes in patients with opioid overdoses are largely unknown.
**Research Question:** What are the laboratory confirmed substances identified and clinical outcomes in young adults presenting to the ED with suspected acute opioid overdose?
**Methods:** This is a subgroup analysis of young adults (18-25y) in a multicenter, prospective cohort study of ED patients with suspected opioid overdose presenting to one of eight sites within the ToxIC network (November 2020-June 2022). Clinical information was collected from medical records. Waste serum was analyzed via a comprehensive LC-QTOF-MS assay to detect various drug constituents. Descriptive statistics were used to describe substances involved and patient outcomes.
**Results:** Of 537 patients with suspected opioid overdose, 8.9% ($n = 48$) were 18-25 years. Ninety-six percent ($n = 46$) had confirmed opioid overdose. Fentanyl was suspected in 22.9% ($n = 11$) of patients, but 83.3% ($n = 40$) had fentanyl/fentanyl analogues detected on laboratory analysis, including 22.9% ($n = 11$) with para-fluorofentanyl and one patient with the novel synthetic opioid, metonitazene. Additionally, 50%

($n = 24$) contained stimulants, predominantly methamphetamine ($n = 20$), and 37.5% ($n = 18$) had benzodiazepines detected. Adulterants were detected in 68.8% ($n = 33$). Sixty-five percent ($n = 31$) had ≥5 different analytes identified. Most patients received naloxone (76.1%), with 51.4% requiring ≥2 doses. While most patients (58.7%, $n = 27$) were discharged from the ED, 22.9% ($n = 11$) were admitted to the ICU, 16.7% ($n = 8$) left AMA, and one patient died. On discharge, 46.8% ($n = 22$) received a naloxone kit, 14.9% ($n = 7$) were prescribed buprenorphine, and 19.1% ($n = 9$) were scheduled for SUD follow-up.

**Conclusion:** Fentanyl/fentanyl analogs were involved in the majority of opioid overdoses in young adults presenting to the ED, though multiple other substances were also detected. A high proportion of patients required ICU admission. These findings can inform targeted harm reduction strategies.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 139. Intravenous Buprenorphine Conversion for Hospitalized Patients on Opioid Agonists

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**Background:** Buprenorphine, a partial μ-opioid receptor agonist, is FDA-approved for the treatment of opioid use disorder (OUD) and pain management. It has high binding affinity and displaces preexisting full-agonist, which can precipitate withdrawal. Because of this property, standard buprenorphine initiation requires patients to have moderate withdrawal prior to dosing. Allowing development of withdrawal is not always feasible, as patients in the acute care setting may require ongoing, full agonist therapy for pain management. "Microinduction" techniques use small, escalating sublingual or transdermal doses of buprenorphine to transition to typical OUD buprenorphine doses are well-described. However, there is little experience using intravenous (IV) buprenorphine, most commonly used for pain.

**Methods:** This is a single-center, retrospective review of patients treated by a medication for addiction treatment (MAT) consulting service from 1/1/2020 to 10/31/2022. Patients who received IV buprenorphine for OUD and acute pain were included. During initiation, patients were continued on full opioid agonists, including methadone. Induction was started with IV buprenorphine 150-300 mcg. If tolerated, a titration of IV buprenorphine 300 mcg every six hours was continued for four doses, followed by sublingual buprenorphine 2 mg every six hours for four doses, and then to a therapeutic dose which ranged from 8-32 mg daily. The full opioid agonist therapy was subsequently discontinued.

**Results:** We identified 19 patients that received IV buprenorphine, and 12 met predetermined inclusion criteria. The average time to tolerate therapeutic doses of 16 mg or more per day was 4.2 days. All patients were successfully transitioned without any reported adverse effects or precipitated withdrawal.

**Conclusion:** The use of IV buprenorphine allows for inpatient transition of patients receiving concomitant full opioid agonists, including methadone, without a period of abstinence. The protocol was well-tolerated with no precipitated withdrawal.

### 140. A Sunny Disposition: Substance Use Navigator (SUN) Associated with Decreased Hospital Utilization

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**Background:** Substance use disorders (SUD) play a pervasive role in the determination of health outcomes. SUDs have been associated with increased rates of ED utilization and hospital admissions. We sought to explore the effects of a substance use navigator (SUN) with a Certified Alcohol and Drug Counselor background on hospital utilization.

**Methods:** Utilizing a non-blinded non-randomized trial, a SUN, who was present from eight am to four pm Monday-Thursday would evaluate patients determined to have a SUD. Patients were included if documented to have a SUD. Patients' Electronic Medical Records were followed and queried for repeat ED visits and hospitalizations over the next month and compared against patients with SUD who did not receive SUN services. This data was collected from August of 2020 to April of 2022.

**Results:** Nine hundred fifty-nine hospital encounters were evaluated by the SUN versus 9,997 encounters that were not evaluated by the SUN. Patients initially encountered by the SUN had an additional 178 hospital contacts after their initial visit leading to a 19% rate of hospital reutilization. Patients without SUN evaluations had an additional 4,076 visits leading to a reutilization rate of 41%.

**Conclusions:** Evaluations and interventions by SUN were associated with a significant fall in hospital utilization. Significant limitations included the non-blinded nature of the study and the scarcity of coverage hours available to the hospital by the SUN (32 hours per week).

## 141. The California Substance Use Line: a Collaboration Between the California Poison Control System and National Clinician Consultation Center

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**Background:** In response to the opioid epidemic, California officials funded complementary projects aimed at reducing opioid-related deaths. The California Substance Use Line (CASUL) is the first collaboration of its kind, involving the California Poison Control System (CPCS) and National Clinician Consultation Center (NCCC). The two programs united to offer healthcare providers access to 24/7 expert clinical consultation regarding the management of patients with substance use disorders.
**Methods:** Leadership from CPCS and NCCC planned operational and workflow adjustments and conducted internal staff training. The team created a unified phone number which routed calls to either CPCS or NCCC based on provider practice settings. The team also developed processes for inter-program call transfers and cross-program capacity building. Data collection included caller and patient demographics, reason for call, and caller satisfaction/consultation experience.
**Results:** Since April 2019, the CASUL has provided over 2,614 tele-consultations. Most calls came from healthcare providers working in community clinic settings (48%), while 35% were from emergency departments, and 8% were from inpatient settings. Fifteen percent of calls were regarding older adults (age > 50 years) and 7% were regarding patients who are pregnant/parenting. Calls were predominantly related to the management of patients on prescription opioids (59%) and non-prescription opioids (35%). Most calls (66%) pertained to initiation of medications for treatment of a substance use disorder. Overall, callers reported the consultation deepened their knowledge of substance use disorders, gave them more confidence, and increased their motivation to provide person-centered care.
**Conclusions:** Combining the expertise of medical toxicologists and addiction medicine specialists from CPCS and NCCC, respectively, the CASUL was effectively integrated into the state's public health response. The CASUL plays a unique, critical role in providing equitable access to clinical consultation in California, and improves callers' knowledge, skill and confidence in treating Californians with substance use care needs.

## 142. Systemic Toxicity after Rattlesnake Envenomation in Patients Using Angiotensin Converting Enzyme Inhibitors in the North American Snakebite Registry

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**Background:** Rattlesnake venom may increase bradykinin levels via both bradykinin-potentiating peptides which bind bradykinin receptors or inhibit angiotensin converting enzyme (ACE), and kallikrein-like enzymes, which increase bradykinin formation from kininogens. Use of ACE inhibitors (ACEI) also raises bradykinin levels.
**Research Question:** Is there an association between ACEI use and systemic venom effects following rattlesnake envenomation (RSE)?
**Methods:** This was a cohort study utilizing Toxicology Investigators Consortium (ToxIC) North American Snakebite Registry (NASBR) data. Patients with RSE between 1/1/2013-12/31/2021 reporting ACEI use (ACEI group) were compared to patients without ACEI use (No ACEI group). Primary outcome parameters were systemic venom effects (hypotension, vomiting, diarrhea, angioedema, and/or respiratory failure). Secondary outcomes included length of stay and total number of antivenom vials administered. Chi-Square, Fisher Exact, and Mann Whitney U Tests were used. Logistic regression models were computed for systemic toxicity; Poisson regression models were constructed for a number of antivenom vials. Analyses were conducted in R 4.1.2.
**Results:** 43 (5.3%) patients were in the ACEI group and 775 (94.7%) in the No ACEI group. Groups were similar regarding gender, state where bite occurred, bite location, time to antivenom, and acute antivenom reactions. ACEI patients had more hypotension (18.6% vs. 6.5%; $p = .008$) and more diarrhea (11.6% vs. 2.1%; $p = 0.003$). There were no differences in overall systemic toxicity between ACEI usage and no ACEI usage. Total antivenom vials (both Fab and Fab2) were similar between groups, however ACEI use was associated with more Fab vials compared to no ACEI use (Est: 0.17; 95% CI: 0.45, 0.77) when adjusting for covariates. Lengths of stay were similar between groups.
**Conclusion:** In the NASBR, patients who use ACEIs are more likely to experience hypotension and/or diarrhea after

RSE than are patients who do not. ACEI usage was also associated with receiving a higher number of Fab vials.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

**Day 3: Moderated Posters, Abstracts 143-149**

### 143. Ethanol and Cannabis Prevalence Among 55-64-Year-Old ED Fall Patients Requiring a Trauma Team Evaluation

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**Background:** Previous research on falls and substance use has primarily focused on older adults. However, less is known about falls sustained by 55-64 year-olds. To better characterize substance use associated with falls in this age group, we evaluated the prevalence of ethanol and cannabis detected among patients 55-64 years-old evaluated in an emergency department (ED) after a fall.
**Methods:** Study participants were 55-64 years-old presenting to our New England ED May 2020 to July 2021 after a fall and meeting American College of Surgery criteria for a trauma team evaluation. Biobanked blood samples were assayed for ethanol and cannabinoids. Blood ethanol concentrations were assessed via gas chromatography flame ionization detection (GC-FID). Qualitative cannabinoid testing for tetrahydrocannabinol and two additional metabolites were performed by LC-QTOF-MS. We estimated ethanol and cannabinoid prevalence with corresponding 95% confidence intervals (CIs).
**Results:** Of the 76 participants, their median age was 59 (IQR 58-61) years; 82% were male and 18% female. Ethanol and cannabis were identified in 40.8% (95% CI 29.7-52.7%) and 27.6% (95% CI 18.0-39.1%) of participants, respectively; for 11.8% (95% CI 4.6-19.1%), both ethanol and cannabinoids were present. Blood alcohol concentrations (BAC) ranged from 42-365 mg/dL, with a median ethanol level of 209 mg/dL (IQR 125.5-290.5 mg/dL).
**Conclusion:** The prevalence of alcohol (40.8%) and cannabinoids (27.6%) indicate common use among these 55-64 year-old ED patients requiring a trauma evaluation after a fall. Given the presence of these substances and the measured ethanol concentrations, substance-induced psychomotor impairment may have contributed to the falls. Additional research focused on substance use as part of a fall prevention toolkit for this age group is needed.

### 144. Drug Overdose Testing (DOT) Preliminary Service Data Acceptability and Feasibility

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**Background:** Current biological surveillance programs fail to provide real-time, actionable information back to people who use drugs (PWUD), hindering efforts to take actionable steps to prevent overdoses and reduce drug-related harms. Data demonstrate that PWUD take preventative risk reduction actions when they learn what their drugs contain, and most frequently request drug testing after overdose.
**Research Question:** What is the feasibility and acceptability of ED-based LC-QTOF-MS overdose testing with rapid results feedback directly to PWUD?
**Methods:** A consecutive sample of adult ED patients with unintentional drug overdose were prospectively enrolled at ED visit. Urine and blood comprehensive LC-QTOF-MS toxicology testing was conducted in the hospital toxicology laboratory. Results and clinical interpretation were relayed to participants within three business days of overdose via telephone call, text, or email.
**Results:** Testing results were successfully communicated, and a post survey completed by 62 (82%) of 76 enrolled participants. Of those, 97% reported being very satisfied or satisfied with the information they received, and only two participants reported being either indifferent or dissatisfied. The vast majority (81%) of participants reported "yes, definitely" that they would use the service again, with only one participant reporting that they would not. Participants responded that this information would change their drug use behavior: 73% reported an increased likelihood to use slowly or use trial doses and 63% reported an increased likelihood to use when others are present or can check on them frequently. Immediately after overdose 46% responded that

they were "very concerned" about drug supply safety; after receiving testing results, that number rose to 61%.
**Conclusion:** This study demonstrated the feasibility and acceptability of providing advanced overdose exposure testing data to patients after overdose. This service model demonstrates a unique harm reduction, ED-based intervention that shifts the paradigm of overdose testing towards patient-centered rapid data sharing.

### 145. Geographic Variation of Opioid Use Discussions Tracks Geographic Variation in Opioid-Associated Use

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**Background:** There is substantial variation in opioid-associated mortality in coingestants between rural and urban milieus. We and other groups have demonstrated that social media can be an early warning system for spikes in opioid use. The objective of this study was to determine whether social media also tracks the geographic variation reported by formal surveys.
**Methods:** We acquired publicly available tweets from January 1, 2012 to August 30, 2022 that mentioned an opioid and had explicit latitude and longitude coordinates. We included tweets whose text contained a keyword from previously published lists of opioids. For each year we calculated the $\chi^2$-statistic to evaluate the association between geographic milieu and types of opioids mentioned, using the Benjamini-Hochberg procedure to limit the false discovery rate to 0.05. To define rural and urbanized areas, we used the US Census Bureau 2020 boundaries.
**Results:** We obtained 24,342,393 tweets of which 686,184 (2.8%) contained explicit latitude and longitude coordinates, 580,598 (85%) of which contained unique text and 351,202 (51%) of which were from the United States. Of those 351,202 tweets from the United States, 220,718 (63%) were in urbanized areas. The fraction of tweets from rural areas sharply increased in 2016, driven by mentions of fentanyl and its derivatives. Novel synthetic opioids were more common in tweets from urbanized areas than rural areas in 2012-2015 (all corrected $p$-values $< 0.05$) but more common in tweets from rural areas than urbanized ones in 2021 and 2021 ($p$-values $< 0.01$). These trends significantly correlated with Centers for Disease Control and Prevention mortality reports ($r = 0.88$, $p = 0.025$).
**Conclusion:** Social media postings track the geographic variation in usage reported in federal surveys. Our study is limited by reporting bias as users may choose to turn their location off. We did not account for migration between social media platforms or areas of the country.

### 146. Utilization of a Mobile Addiction Service Within a Vulnerable Population

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**Background:** Opioid overdoses in the US remain a major cause of morbidity, mortality, and healthcare expenditure. The burden of this epidemic is asymmetric, affecting vulnerable populations with less access to healthcare and resources. A solution to this inadequate access to care is the development of mobile addiction services, such as the Road to Care (RTC) mobile addiction service in Worcester, Massachusetts, which can provide medications for opioid use disorder (MOUD). There is a paucity of research regarding the utility and demand for these services.
**Hypothesis:** Does implementation of mobile, low-barrier access to MOUD lead to persistent utilization in a vulnerable population?
**Methods:** This is a retrospective observational study of subjects presenting to the RTC mobile clinic between May 2021 and September 2022. Appropriate patients were offered a seven day prescription for buprenorphine and advised to return for renewal. Demographic and visit data were obtained via electronic medical record. The main outcome variables of interest were number of encounters and number of buprenorphine prescriptions per unique client, and both were evaluated in multiple subgroups. Differences in continuous variables were compared using ANOVA, Wilcoxon Ranks Sum or Kruskal–Wallis tests.
**Results:** Seven hundred eighty three unique patients were seen within the study period, 47% ($n = 366$) having at least two visits. The sample was 38% female, 65% Caucasian, and 21% Latino. Of these patients, 23.2% ($n = 182$) received at least one prescription for buprenorphine, 67.6 % ($n = 123$) of those returned to receive at least one additional prescription for buprenorphine (mean number of buprenorphine prescriptions per subject 5.621 (SD = 6.229)). There were no significant differences in number of repeat encounters or number of buprenorphine prescriptions by sex, ethnicity, or primary language.
**Conclusion:** Low-barrier access to MOUD through a mobile clinic leads to high rates of utilization and return for prescription renewal in a vulnerable population.

## 147. Pumping the Brakes on Precipitated Withdrawal with a Transdermal Buprenorphine Patch

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**Background:** Precipitated withdrawal (PW) is a complication of buprenorphine induction, especially while patients are taking full opioid agonists (FOAs).
**Hypothesis:** A transdermal buprenorphine patch (TBP) is a micro-induction strategy that allows patients to continue FOAs while transitioning to sublingual (SL) buprenorphine with low incidence of PW.
**Methods:** This is a quality improvement retrospective cohort study from January 1, 2019 to December 31, 2021. Patients met inclusion if they received a TBP for SL buprenorphine induction based on pharmacy dispensing and billing data and were prescribed FOAs within 24 hours of SL induction. Data abstracted included: patient demographics; methadone dosing, TBP dose, and oral morphine equivalents (OMEs) prior to SL induction; and documentation of PW. PW was pre-defined as: physician or nursing documentation of PW; an increase in Clinical Opioid Withdrawal Scale by > five points after SL buprenorphine dosing; or documentation of induction termination secondary to PW.
**Results:** Sixty-six cases were analyzed. Six patients (9.1% [95% CI: 3.4-18.8]) developed PW. The average TBP dose and patch time was 40 mcg and 39.9 hours respectively. The median OMEs 24, 12, and six hours prior to SL induction were 45 (IQR: 15-84), 17.75 (IQR: 0-42), and 0 (IQR: 0-15) respectively. Patients with PW had higher median doses of methadone 72 (45 mg vs zero mg; $p = 0.01$) and 48 hours (40 mg vs. 0 mg; $p = 0.009$) prior to induction. Individuals with hepatitis were 2.2 times more likely to experience PW (83% vs. 37%; absolute difference 46% [95% CI: 14-79%]; $p = 0.04$). The most frequent withdrawal symptoms were sweating ($n = 5$), anxiety/irritability ($n = 4$), and body aches ($n = 4$).
**Conclusion:** A TBP can facilitate SL buprenorphine induction, while continuing FOAs, in < two days with a low incidence (<10%) of PW. Care should be taken during induction with patients who are on methadone or have a history of hepatitis.

## 148. Engagement in Buprenorphine Treatment for Opioid Use Disorder in a LatinX Border Community

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**Background:** Emergency department (ED) based delivery of medication for opioid use disorder (MOUD), specifically buprenorphine, is associated with long term engagement in addiction treatment with potential decrease in illicit opioid use and subsequent mortality.
**Research Question:** We looked at long term success in MOUD engagement among LatinX patients, which have been underrepresented in prior studies, from a poor border community using a Substance Use Navigator (SUN) embedded in the ED.
**Methods:** Along with the SUN, we approached patients identified as having OUD who presented to El Centro Regional Medical Center ED M-F 8a to 5p from 2/1/19 to 6/30/20. Patients were offered buprenorphine (8-16 mg) initiated at index ED visit, and referred for outpatient treatment, including a five day buprenorphine prescription. We assessed for engagement in ongoing OUD treatment at seven and 30 days, defined as enrolled in our outpatient treatment center and having filled a prescription of buprenorphine attested by the California Controlled Substance Utilization (CURES) database.
**Results**: With the support of a SUN in the ED, we approached 101 patients to begin MOUD. After one elective withdrawal, we enrolled and initiated MOUD treatment in 75 ED patients with median age 40 (range 20-67) years, gender 57 (76%) male, and LatinX 67/75 (89%). Follow up at seven days, showed 42/75 (56%; 95% C.I. 45 to 67%), and at 30 days at 30/75 (40%; C.I. 30 to 51%) still engaged in ongoing MOUD. Two patients that left MOUD within the first week later reengaged by 30 days. There were no deaths in any of the 75 patients within the time period studied.
**Conclusion:** Embedding a SUN in a community border ED allowed engagement in ongoing MOUD of almost half of predominant LatinX patients presenting with OUD. Such strategies may lead to decreased mortality and subsequent acute care utilization.

### 149. Squashing the Buzz on Wasp Dope

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**Background:** Wasping has gained media attention due to rising use in rural America as a means to get high. Wasp dope is reportedly formed by spraying aerosolized insecticide onto an electrified screen to form a substance resembling crystal methamphetamine. Use is reported to cause agitation and erratic behavior.
**Hypothesis:** By applying either an electric current or heat through a metal screen sprayed with aerosolized insecticide, crystals will be formed.
**Methods:** Three commercially available aerosolized insecticides were obtained from local hardware stores (one containing prallethrin, one containing imiprothrin, and one containing tetramethrin, permethrin, and piperonyl butoxide). Two different sizes of wire mesh (10-mesh and 20-mesh) were used as collecting screens and placed between two cinder blocks with aluminum foil below to collect any crystals. The screens were attached to a 12 volt battery via jumper cables to create an electrical current. Three trials were run with each screen. During the first trial, the different sized screens were sprayed with each type of spray and then the current was applied. During the second trial, the current was applied first and then the screens were sprayed. The third trial involved spraying the screens and then heating with a propane torch. The screens and foil were examined for the formation of crystals which could then be analyzed via gas chromatography/mass spectrometry.
**Results:** No crystals were formed from any method. The jumper cables burned through the mesh screens during each trial. Methods to mitigate this were unsuccessful. Noxious fumes were the only product of the experiment.
**Conclusion:** Producing wasp dope through the methods detailed online appears unfeasible. Further research would be required to determine if the methods mentioned online are capable of producing the product or whether this is a myth being perpetuated through the online community and the media.

## Day 3: Posters, Abstracts 150-208

### 150. Palytoxin Poisoning in an Aquarium Enthusiast

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**Background:** Palytoxin is a highly potent toxin originally isolated from the coral Palythoa toxica and subsequently identified in a variety of marine organisms. By converting Na+/K+-ATPase into a nonselective cation channel, palytoxin causes disruption of cellular ion gradients. Zoanthid coral species kept in home aquariums have been found to contain varying levels of palytoxin, making this a potential risk for aquarium enthusiasts.
**Methods:** This is a single patient chart review through a regional poison center.
**Results:** A 54-year-old male with a past medical history of hypertension and hyperlipidemia who presented to the emergency department complaining of muscle weakness, headache, and oral pain five hours after propagating coral in his home aquarium. He handled the coral over a period of four hours and reported putting his hand to his mouth after touching the colonies. On exam the patient appeared confused but not in any respiratory distress. Vital signs were within normal limits except for a blood pressure of 163/96 mmHg. ECG demonstrated normal sinus rhythm with a normal rate and intervals. Initial labs showed mildly elevated transaminases (AST 97 IU/L, ALT 77 IU/L), a creatinine of 1.4 mg/dL, and an elevated creatinine kinase. The patient was admitted to the ICU where he initially complained of severe back pain, which improved with fentanyl and hydromorphone. The following morning, the patient's confusion had resolved, but he reported a persistent headache and muscle aches. Creatinine kinase was noted to be 1,600 IU/L and declining. Symptoms resolved with intravenous fluids and analgesics. He was transferred to the floor on hospital day three and discharged home on day four with no persistent effects.
**Conclusion:** Significant palytoxin poisoning can occur due to contact with coral in home aquariums. These exposures can lead to myotoxicity and may require ICU admission.

### 151. Valproic Acid Toxicity After Initiation of Injectable Weight-Loss Drug: a Case Report

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**Background:** Tirzepatide (Mounjaro™) injection is a novel glucose-dependent insulinotropic polypeptide receptor and glucagon-like peptide-1 receptor agonist indicated as adjunct therapy in adults with type two diabetes mellitus and off-label for weight-loss. There is limited information surrounding drug-drug interactions.
**Methods:** A 50-year-old-male with a history of epilepsy was initiated on tirzepatide 2.5 mg once weekly injections

for weight-loss. The patient had received a total of three injections prior to emergency department (ED) referral for malaise, decreased hearing, and thrombocytopenia with petechial rash. The patient had experienced worsening anorexia three weeks prior to presentation, which deteriorated to extreme fatigue, ataxia, and encephalopathy. Laboratory derangements included: valproic acid (VPA) concentration 220 mcg/mL, ammonia 63 mcMol/L, platelet 40 x10^3/cm, and sodium 126 mMol/L. Notably, the patient had been seizure-free and therapeutic on his oral antiepileptic regimen of divalproex sodium extended-release (ER) 1,500 mg twice daily and levetiracetam 1,000 mg daily since 2018. VPA therapy was held, levocarnitine therapy initiated, and complete blood counts followed closely. Patient was discharged on hospital day six.

**Results:** Serum concentrations of free VPA and levetiracetam were obtained in the ED. The levetiracetam concentration was within normal limits (19.8 mcg/mL, range: 6-46), while the free VPA concentration was 39.4 mg/L (range: 4.8-17.3). Tirzepatide slows gastric emptying and is extensively protein bound to albumin. Given these pharmacokinetic parameters, it can be stipulated that initiation of tirzepatide led to an increase of free VPA and contributed to subsequent toxicity.

**Conclusion:** Limited drug interaction information exists between tirzepatide and VPA. Given the effects on gastric emptying, ER formulations may exhibit increased bioavailability. Competition may occur at protein binding sites further increasing available free drugs. Pharmacokinetic and pharmacodynamic interactions should be considered when initiating tirzepatide and therapeutic drug monitoring, if available, should occur more frequently with ER formulations.

## 152. Intra-Arterial Zolpidem Injection Resulting in Digital Ischemia and Bacteremia

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**Background:** Zolpidem contains a microcrystalline cellulose component which is insoluble and resists degradation, resulting in micro-emboli. Intra-arterial injection can result in ischemic injury that is refractory to many interventions.

**Methods:** This is a single patient chart review including consent for pictures and publication. A 33-year-old male with a history of substance use disorder, seizures and depression presented to the emergency department after injecting 60 mg of solubilized zolpidem into his right antecubital fossa for recreational use. Patient reported having experience with intravenous zolpidem and felt the injection was in the correct location. However, immediately following injection, he developed pain and swelling around the injection site followed by hand pain and paresthesias shortly after.

**Results:** On examination, the hand was mottled with normal radial/ ulnar pulses but delayed capillary refill. Given concern for vascular compromise, a heparin infusion was initiated. A CT angiography of the extremity demonstrated patent arteries. Hand surgery recommended aspirin, amlodipine, topical nitroglycerin, and elevation of the extremity for presumed small vessel occlusion. Ketamine was initiated for pain control as the patient was taking buprenorphine. Blood cultures grew *Strep viridans* and were treated with ceftriaxone and vancomycin. The workup for infective endocarditis was negative. After gradual improvement of the skin exam and pain, the patient was discharged on hospital day 10 with oral clindamycin.

**Conclusion:** Zolpidem contains microcrystalline cellulose that may embolize with unintentional intra-arterial injection, causing small vessel occlusion and digital ischemia. Traditional therapies for arterial occlusion have an unclear role.

## 153. Gluts of GLP-1: a Case Series of Semaglutide Overdose Through Administration Errors

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**Background:** Prescriptions of semaglutide, a Glucagon-Like Peptide-1 (GLP-1) receptor agonist administered weekly for type two DM and obesity, are increasing. Adverse effects (AEs) from semaglutide overdose are poorly described. We report AEs from three unintentional semaglutide overdoses upon initiation.

**Methods:** This is a case series at an academic center.

**Results:** Case 1: A 53-year-old man unintentionally injected a 2.66 mg pen of semaglutide instead of the recommended 0.13 mg. He presented with severe singultus, emesis, epigastric pain, oral (PO) intolerance, and weakness. Initial blood gas, cellularity, chemistry, and lipase were unremarkable. A CT scan demonstrated distal esophageal wall thickening. Treatment included intravenous fluids (IVF), antiemetics, and potassium repletion. He required hospitalization for one day. Case 2: A 45-year-old woman unintentionally injected a 2.5 mg pen of semaglutide instead of 0.25 mg. She developed throat discomfort, emesis, generalized abdominal pain, and food intolerance. Diagnostic evaluation included a normal blood gas, cellularity, chemistry, and lipase. Treatment included IVF and antiemetics. She remained hospitalized for

2 days, although experienced vomiting and dehydration for one week. Case 3: A 33-year-old woman obtained a semaglutide pen online and injected the entire 1.7 mg contents. She presented with nausea, emesis, abdominal pain, weakness, and headache. Labs revealed a lactate of 2.5 mmol/L. She received IVF and antiemetics. Her lactate normalized and she was discharged three hours later after tolerating PO. No patient experienced hypoglycemia.
**Conclusion:** We report AEs from unintentional semaglutide overdoses. Nonspecific gastrointestinal symptoms predominated, precluded oral intake, and were prolonged in two patients. In therapeutic administration, GLP-1-associated gastrointestinal disturbances present in up to a third of patients and lead to cessation. This case series highlights the critical role of patient education and training upon initiation of semaglutide therapy to minimize administration errors and AEs from injectable antiglycemics.

### 154. Cardiotoxicity Secondary to Oral Pilocarpine Indicated for Xerostomia

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**Background:** Oral pilocarpine is an approved treatment for xerostomia. Toxicity has been infrequently reported in literature. Few case reports describe toxicity occurring from ingestion. We report a case of toxic effects subsequent to recent initiation of oral pilocarpine in a patient with xerostomia.
**Hypothesis:** Pilocarpine toxicity, in addition to inducing cholinergic effects like diaphoresis, lacrimation, and miosis, may be associated with significant cardiac effects including complete heart block.
**Methods:** This is a case report involving a 36-year-old male recently prescribed pilocarpine for treatment of xerostomia. The patient presented to the emergency department with bradycardia (heart rate, 45 beats/minute), diaphoresis, lacrimation, miosis, and electrocardiogram showing a third-degree heart block. He was hypertensive and bradycardic with a rate 45 beats/min. He was alert and oriented without oral secretion or respiratory abnormalities. He was initially administered atropine 1 mg intravenously for the heart block and cholinergic symptoms. Toxicologists were consulted and recommended holding off further atropine dosing since the patient was not otherwise exhibiting evidence of poor perfusion. The patient was admitted and with cardiology consultation for discussion of pacing for persistent heart block.
**Results:** The patient remained bradycardic with a heart rate in the 30s-40s beats/minute with continued heart block. He remained hemodynamically stable with troponin of 0.04 ng/ml. No further atropine was administered and the patient was examined by an electrophysiologist. Pacing was not performed with heart block resolved by hospital day two.
**Conclusion:** Pilocarpine is a muscarinic agonist at all muscarinic receptors. This patient exhibited muscarinic effects including miosis, diaphoresis, and lacrimation in addition to bradycardia, in addition to a rarely reported third-degree heart block which resolved without invasive intervention. This case highlights the potential for significant cardiac effects following oral pilocarpine exposure and success with conservative management.

### 155. Pediatric Oral Desmopressin Acetate Overdose Leading to Clinically Significant Toxic Effects

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**Background:** Desmopressin is a synthetic analogue of antidiuretic hormone. It is used to treat nocturnal enuresis and central diabetes insipidus as it promotes the conservation of water in the kidneys. While toxicity has been rarely reported, overdose can lead to neurological complications including altered mental status and seizures due to hyponatremia.
**Hypothesis:** Oral desmopressin overdose can lead to clinically significant neurological adverse effects in children, including hyponatremic seizures.
**Methods:** This is a case report of a 15-month-old male with a reported ingestion of an unknown amount of desmopressin acetate 0.2 mg tablets. The patient experienced seizure activity and was brought to the pediatric emergency department in a post-ictal state. His vital signs upon arrival were stable; however, his laboratories were significant for hyponatremia with a sodium of 118 mEq/L. The poison center was consulted who discussed treatment with either 0.9% sodium chloride or 3% hypertonic saline along with monitoring of serum electrolytes, serum osmolality, and seizure precautions with benzodiazepines. The patient remained altered with somnolence and drowsiness.
**Results:** Due to the acute overdose, he was administered a bolus of 3% hypertonic saline followed by an infusion of 5% dextrose/0.9% sodium chloride at 20 ml/hour and titrated down to 10 ml/hour. His repeat sodium levels improved to 128 mEq/L with an improvement in mental status. He did not experience further seizure activity and subsequent

sodium levels normalized (136 mEq/L). He was discharged on hospital day two.
**Conclusion:** Desmopressin overdose can cause severe hyponatremia and neurological toxicity, including seizures. Overdose is rarely reported and most often involves nasal spray formulation. Our patient presented with an ingestion of an unknown quantity of desmopressin tablets with subsequent seizure activity and was effectively treated with 3% hypertonic saline and intravenous fluid infusion.

### 156. Oxybate Salts: Acute Respiratory Failure from Mistiming One Night's Doses

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**Background:** Salts of oxybate (gamma-hydroxybutyrate) are prescribed to treat narcolepsy with cataplexy. As gamma-aminobutyric acid (GABA) receptor agonists, efficacy is hypothesized to be mediated through modulation of GABA-B receptors. Dispensed as concentrated solutions, patients are responsible for storage and reconcentration of these central nervous system (CNS) depressants. One-half the nightly dose is typically taken once the patient is in bed, with the other half taken 150-240 minutes later.
**Hypothesis:** Inadvertent mistiming of one night's doses of oxybate salts can result in respiratory failure.
**Methods:** This is a single-patient case report of a 19-year-old with a history of narcolepsy with cataplexy who inadvertently self-administered their second nightly dose of four grams oxybate salts 90 minutes after the initial four-gram dose, instead of after the minimum recommended 150 minutes.
**Results:** Shortly after the second dose, the patient became unresponsive, with a Glasgow Coma Scale (GCS) of three upon emergency medical services (EMS) arrival. In the emergency department, their respiratory rate was two breaths/min and O2 saturation 88%, prompting intubation and mechanical ventilation after no response to naloxone. Nine hours later their mentation and respiratory effort improved, and they were extubated. Upon further history, the patient had previously used a timed lockbox, set at 150 minutes before allowing access to the second nightly dose. They instituted this safety measure themselves but no longer utilized it after moving away to college.
**Conclusion:** Oxybate salts are potent CNS depressants which can lead to significant respiratory depression even at prescribed doses. Considering these medications are redosed overnight, there is considerable risk of error. Substantial attention to spacing of doses is critical, and mechanisms to prevent inadvertent early administration may mitigate the inherent risks of these drugs. Cases of inadvertent therapeutic error, even too narrow spacing of a single night's doses, may require immediate referral to a health care facility.

### 157. Frequency of Return ED Visits After Antihistamine Prescription in Patients > 65 Years of Age

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**Background:** The American Geriatrics Society Beers Criteria lists antihistamines as a potentially inappropriate medication (PIM). Antihistamines can cause adverse effects such as delirium, urinary retention, and falls. We sought to evaluate the frequency of return ED visits after an antihistamine prescription in patients ≥ 65 years of age.
**Methods:** All data abstraction was performed by the primary author. All antihistamine prescriptions from the ED for the six month period from July 1-December 31, 2019, for patients aged 65 or older were reviewed. Age, gender, diagnosis, antihistamine prescribed, and duration of treatment were recorded. Return ED visits during the 30 days after prescription for falls, change in mental status, or urinary retention reviewed, as well as overall visits or hospital admissions during that time period. A convenience sample of patients with similar diagnoses who did not receive any antihistamines, were evaluated for comparison.
**Results:** 80 patients received an antihistamine prescription. The most common diagnoses were: upper respiratory infection, sinusitis, vertigo, dizziness, and dermatitis. Seventy-eight controls with similar diagnoses were identified. The patients were male (89% and 90%). Median age in the antihistamine group was 71 years, vs. 77 years in the controls. The most common antihistamine was chlorpheniramine (n - 41), followed by meclizine ($n = 22$), cetirizine ($n = 14$), and diphenhydramine ($n = 4$). One patient received a prescription for both chlorpheniramine and cetirizine. In 30 day follow-up, only urinary retention ($n = 6$ vs. 3 in control) occurred with increased frequency. There were similar visits for falls, mental status change, and overall rate of admission ($n = 3.9\%$ vs. $3.8\%$, $p = <0.01$).
**Conclusion:** In our study we did not detect any significant difference in revisits or admissions for complaints other than urinary retention. This may have reflected choice of antihistamine, a younger cohort who received antihistamines, or

brief duration of therapy. Larger observational studies may be needed.

### 158. Drug Interaction with a Novel COVID-19 Oral Agent With Resultant Intubation

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**Background:** During the COVID-19 pandemic, the Food and Drug Administration (FDA) granted emergency use authorizations (EUA) to several novel medications including Paxlovid (nirmatrelvir/ritonavir.) Using unfamiliar EUA drugs may cause inadvertent drug-drug interactions.
**Hypothesis:** Co-administration of nirmatrelvir/ritonavir and cariprazine decreased cariprazine metabolism causing central nervous system (CNS) depression requiring intubation.
**Methods:** This is a single-patient retrospective chart review. A 55-year old man with a history of intellectual disability and schizophrenia presented from his residential treatment facility with profound CNS depression requiring intubation for airway protection. Computed tomography and angiography of his head and neck revealed no acute abnormalities. EEG showed nonspecific background slowing consistent with toxic metabolic encephalopathy. He had been diagnosed with COVID-19 three days prior and started on Paxlovid. Toxicology was consulted for evaluation of possible pharmacological toxicity. Pharmacy records revealed daily cariprazine therapy.
**Results:** Cariprazine is a third-generation antipsychotic used to treat bipolar disorder and schizophrenia. It has a long half-life with active metabolites. This patient was started on Paxlovid, a known CYP-3A4 inhibitor, and was continued on the same dose of cariprazine, potentially increasing cariprazine adverse effects which include seizures and somnolence. A comprehensive drug screen was positive for loxapine, which was not prescribed. Interestingly, there was no detectable amoxapine, a loxapine metabolite, which would likely be positive in the setting of chronic use. There is no current literature that suggests that cariprazine and loxapine cross-react, but this may explain the isolated positive result. Cariprazine was held, and the patient's mental status improved. He was extubated on hospital day four and discharged.
**Conclusion:** The EUA of medications like Paxlovid may prove dangerous when prescribers are unfamiliar with their metabolism and may cause significant drug-drug interactions which is the proposed mechanism of altered mental status in this case. These conclusions are limited by their descriptive nature and lack of quantitative drug levels.

### 159. Akathisia Associated with Prochlorperazine in the Emergency Department: Incidence and the Impact of Prochlorperazine Dose and Diphenhydramine Pre-Treatment

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**Background:** Akathisia is a known adverse effect of prochlorperazine (PCZ) administration and is typically treated with an anti-muscarinic agent such as diphenhydramine (DPH). There is minimal high-quality research on the effect of PCZ dose and DPH pre-treatment on akathisia incidence in the Emergency Department (ED) setting.
**Research Question:** What is the incidence of akathisia after PCZ in the ED? How do PCZ dose and DPH pre-treatment affect the incidence of akathisia?
**Methods:** We performed a retrospective chart review cohort study at a large tertiary care center ED. Data were exported from the electronic medical record system for all patients > 18 years of age with encounters in the ED between July 2018 - June 2022 who received intravenous PCZ for any indication. Data reviewed included DPH administration, dose of PCZ, ED LOS, and disposition. We used the administration of DPH at least 15 minutes after PCZ as a proxy for akathisia severe enough to warrant pharmacologic treatment. Descriptive statistics and relative risks were calculated using Microsoft Excel.
**Results:** 1,874 patient encounters met inclusion criteria. Of these, 1,095 (58.4%) received 5 mg or less of PCZ, and 779 (41.6%) received 10 mg. A total of 365 patients (19.5%) were pre-treated with DPH. Twenty-eight patients (1.5%) were treated with DPH after PCZ and thus met study criteria for akathisia. The relative risk of akathisia in patients receiving DPH pre-treatment (as compared to those not receiving DPH pre-treatment) was 0.32 (95% CI 0.31844– 0.31844). The relative risk of akathisia in patients receiving 5 mg or less of PCZ (as compared to those receiving 10 mg of PCZ) was 0.71 (95% CI 0.71141– 0.71142).
**Conclusion:** The incidence of akathisia warranting pharmacologic treatment after PCZ was low in this large real-world retrospective cohort study. DPH pretreatment and lower PCZ dose were associated with lower incidence of akathisia.

## 160. Remdesivir Discontinuation Based on Thresholds of Transaminase Elevation in an Observational Registry

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**Background**: Remdesivir is an antiviral approved by the United States Food and Drug Administration (FDA) for treatment of COVID-19, and transaminase elevation is commonly reported. Thresholds to be considered for discontinuation due to alanine aminotransferase (ALT) elevation differ between the FDA and European Medicines Agency (EMA).
**Research Question**: The primary objective is to describe transaminase thresholds being used in real-world practice for discontinuation of remdesivir in patients with COVID-19.
**Methods**: This study used a descriptive design based on an ongoing national registry of adverse events, the FDA ACMT COVID-19 ToxIC (FACT) pharmacovigilance project, with 17 participating health systems. Cases were identified retrospectively for an 18-month period (11/23/2020-5/18/2022). Classification of discontinuation as premature and due to abnormal liver biomarkers was based on chart documentation by the treating team, not based on study criteria.
**Results**: Of 1,026 cases in the FACT registry, 121 cases had liver injury supplemental forms completed for transaminase elevation with remdesivir, defined as ALT doubling or increasing by $\geq$ 50 U/L. ALT was elevated prior to remdesivir in 45% and increased above baseline during dosing by a median of 94 U/L (IQR 51-169, max 8,350). Remdesivir was discontinued early in 31% of patients due to abnormal liver tests. The ALT threshold for premature discontinuation was median 202 U/L (IQR 145-396, range 92-5,743). Among 38 patients with premature discontinuation of remdesivir for transaminase elevation, only 21% met FDA criteria to consider discontinuation, and 42% met EMA criteria to consider discontinuation.
**Conclusion**: In this descriptive study of real-world practice, clinicians are overall making more conservative treatment decisions than are recommended for consideration of discontinuation in approved drug labeling, with wide variation in the transaminase thresholds being used.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 161. Severe Adverse Effects After Intrathecal Injection of Gadolinium Based Contrast Agent

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**Background:** Intrathecal gadolinium-based contrast agents (GBCA) are frequently used in patients with iodine-based contrast agent (IBCA) allergies even though this is an off-label use. Intrathecal GBCA can cause mild side effects such as headache and nausea. It can also cause severe adverse effects (AE) such as agitation, seizures, coma and rarely, dysrhythmia and cardiac arrest.
**Methods:** This is a single patient case report. A 56 year-old woman with chronic neck pain and IBCA allergy received one mL 1% lidocaine and seven mL gadoteridol (0.5 mMol/mL) for a magnetic resonance myelogram. Ten minutes later, she became agitated, developed nystagmus, jerking arm movements, and urinary incontinence. In the ambulance, she had a tonic-clonic seizure followed by two episodes of pulseless electrical activity arrest with return of spontaneous circulation after a combined 15 minutes of cardiopulmonary resuscitation.
**Results:** The patient's laboratory results were consistent with seizure and cardiac arrest with lactate 22.1 mMol/L, pH < 6.8, and troponin 293 ng/L. The initial brain CT report stated the findings were consistent with intrathecal GBCA. The first addendum stated it was IBCA. The final addendum affirmed GBCA presence, which precludes detection of other acute pathologies. On day zero, neurology noted exam findings consistent with anoxic brain injury, which could not be corroborated by CT. On day two, EEG showed no seizures, and brain CT showed no intracranial hemorrhage and preserved gray-white matter differentiation. She was extubated on day five, back to baseline mental status by day 11, and eventually discharged to rehab on day 17.
**Conclusion:** Intrathecal injection of GBCA can produce severe neurological and cardiac AE. Early CT brain results are often difficult to interpret and are prone to errors. Outpatient, pre-hospital, and emergency department providers should be aware of this constellation of severe AEs to facilitate timely resuscitation and supportive care to ensure good patient outcome.

## 162. Toxicological Exposures in Patients with QRS Widening as Described in the ToxIC Database

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**Background:** Clinical management of sodium channel blockade and QRS widening in poisoning originated from research regarding tricyclic antidepressant (TCA) overdose. As TCA prescribing decreases, it is important to characterize the agents involved in sodium channel blockade in recent years.
**Hypothesis:** Patients with QRS widening are exposed to antiarrhythmics, antiepileptics, antihistamines, and newer antidepressants.
**Methods:** This is a retrospective analysis of the Toxicology Investigators Consortium (ToxIC) registry. We requested cases from 2010-2021 of adults age 19 and above with documented QRS > 120 ms. We excluded patients whose signs/symptoms were documented "unlikely" related to their exposure, chronic exposures, and "not applicable" exposures/envenomation, as well as those without a toxicological exposure. Our primary outcome was the proportion of patients exposed to each category and specific xenobiotic; secondary outcomes included trends in exposure over time and clinical outcomes.
**Results:** Seven hundred ninety-six patients were included. 738 (92.7%) were 19 – 65 years old, and 421 (52.9%) were female. 38.1% received sodium bicarbonate, 8.54% developed ventricular dysrhythmias, 24.6% received vasopressors, and 6.16% received CPR. The most common exposure categories were antidepressants (40.5%), sedative hypnotics (17.0%), antipsychotics (15.0%), and cardiovascular medications (14.6%). The most common xenobiotic exposures were amitriptyline ($n = 93$, 11.68%), quetiapine (73, 9.17%), bupropion (69, 8.67%), acetaminophen (68, 8.54%), and diphenhydramine (67, 8.42%). The proportion of patients exposed to TCAs peaked in 2016 (33.3%) and have since decreased, while the proportions of exposures to bupropion, lamotrigine, and cardiovascular medications increased over the study period.
**Conclusion:** Amitriptyline is the most common exposure among patients with QRS widening. Other exposures such as bupropion, cardiovascular medications, and lamotrigine are becoming more common. This study is descriptive in nature and cannot establish definitive association between exposure and QRS widening, represented in the prevalence of xenobiotics not typically believed to cause QRS widening (quetiapine, acetaminophen).

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

## 163. QRS Prolongation Associated with Escitalopram Overdose

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**Background:** Escitalopram is a commonly prescribed selective serotonin reuptake inhibitor. Overdose is associated with signs of serotonergic excess. ECG interval changes are rarely described, usually with QTc prolongation. QRS prolongation associated with escitalopram overdose is very rarely reported and interaction with voltage gated sodium channels is poorly described. We describe a case of QRS prolongation and development of a right bundle branch block after isolated escitalopram overdose that improved with administration of sodium bicarbonate.
**Methods:** A 20-year-old patient presented after intentional ingestion of 1,780mg of escitalopram 2.5 hours prior. They were initially tachycardic to 109 BPM with otherwise unremarkable vital signs. Mydriasis, tremor, clonus, hyperreflexia, subjective anxiety, and increased lower extremity tone was appreciated. Initial ECG showed QRS/ QTc of 66, 459 msec respectively. They received 2 mg IV lorazepam with improvement in tremor. They became progressively more tachycardic, with repeat ECG showed QRS prolongation to 136ms with a new right bundle branch block. QTc was prolonged as well, measured at 564 msec. 50mEq of sodium bicarb was administered with improvement in QRS prolongation to 82 msec. Given response to sodium bicarbonate, a bicarb infusion was initiated. No recurrent interval prolongation was noted on serial ECGs. The patient's symptoms improved over the next 24 hours and was successfully dispositioned to psychiatric care.
**Discussion:** QRS interval prolongation is only rarely reported with escitalopram toxicity. This case demonstrates prolongation of the QRS interval with development of a right bundle branch block pattern that was responsive to sodium bicarbonate. No other coingestants were identified. This phenomenon is rarely reported in the literature and interaction of escitalopram with voltage gated sodium channels is not well described. These changes appeared to respond to sodium bicarbonate therapy suggestive of sodium channel blockade.

**Conclusion:** Overdose of escitalopram can cause QRS prolongation that responds to sodium bicarbonate therapy.

### 164. Tacrolimus Toxicity Due to Enzyme Inhibition from Ritonavir

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**Background:** Tacrolimus is used for immunosuppression following solid organ transplantation. Transplant patients with COVID-19 infection are at risk for severe disease and early treatment is indicated; however, the first line agent, nirmatrelvir/ritonavir, is commonly implicated in drug-drug interactions. Hypothesis: Ritonavir, a potent CYP 3A4 inhibitor, can cause tacrolimus toxicity, characterized by hypertension, encephalopathy, and kidney injury.
**Methods:** This is a single patient case report. An 85-year-old woman with a history of renal transplant on tacrolimus presented to the emergency department (ED) with weakness, increasing confusion, poor oral intake, and inability to walk. She was recently diagnosed with COVID-19 infection, and was prescribed nirmatrelvir/ritonavir, which she finished the day prior to presentation. Family confirmed she did not take extra tacrolimus.
**Results**: In the ED, she was dehydrated and had an acute kidney injury (creatinine 2.1 mg/dL, up from 1 mg/dL). Her tacrolimus concentration on admission was 143 ng/mL (5-20 ng/mL). Tacrolimus was held, but the concentration increased to 147 ng/mL, then 189 ng/mL. In conjunction with poison control and transplant nephrology, she was loaded with fosphenytoin 15 mg/kg IV, followed by 100 mg oral phenytoin three times/day for CYP3A4 induction. The tacrolimus concentration trended downward and fell into therapeutic range (16.1 ng/mL) on hospital day seven. Her renal function also slowly returned to baseline. Her hospital course was complicated by atrial fibrillation with rapid ventricular response and hypertension, requiring a diltiazem infusion, and a urinary tract infection. She was discharged to a rehabilitation facility after a 17 day hospitalization.
**Conclusion**: Enzyme inhibition with ritonavir can complicate treatment of COVID-19 infection in patients on tacrolimus. CYP 3A4 enzyme induction is a well-tolerated and viable treatment option; however, toxicity can be prevented by providers being cognizant of drug-drug interactions prior to prescribing.

### 165. Threading the Needle: Ultrasound-Guided Aspiration as Treatment for Inadvertent, Subcutaneous Medication Administration during Intrathecal Pump Refill

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**Background**: Opioids, clonidine, and local anesthetics can be administered intrathecally via a drug delivery system for chronic pain conditions. If the pump reservoir is missed during refill lethal doses of medications can be injected into the subcutaneous tissues.
**Methods**: This is a single patient chart review of a 76-year-old female who presented to the emergency department (ED) unresponsive after inadvertent medication administration subcutaneously during an intrathecal pump refill. The refill contained 32 mg of clonidine, 600 mg of bupivacaine, and 1200 mg of hydromorphone in 40 mL. During the procedure the medication was unintentionally administered subcutaneously next to the pump reservoir. Aspiration was attempted in the pain clinic with a return of 12.5 mL of fluid, potentially leaving 27.5 mL remaining in the tissue with 825 mg hydromorphone, 412.5 mg bupivacaine, and 22 mg of clonidine. The patient became bradycardic and unresponsive shortly thereafter. On arrival to the ED her initial vitals were HR 43, BP 197/99, Temp 36.2 C, RR 19, saturating 96% on 2 L of oxygen. Despite multiple doses of naloxone she remained unresponsive and was intubated.
**Results**: Bedside ultrasound in the ED revealed a fluid pocket at the site of administration. Interventional radiology (IR) was consulted for drainage of the fluid pocket and 44 mL of fluid was extracted. The fluid was sent for analysis and only the hydromorphone level was able to be obtained. The level was 7.4 mg/mL, indicating the fluid pocket did contain some of the medication intended for the pump refill. After continued supportive care the patient was extubated on day three and was discharged on day five of hospital stay.
**Conclusion**: Ultrasound-guided medication aspiration can be utilized in cases of inadvertent subcutaneous injection during intrathecal pump refill and may reduce the severity of overdose.

## 166. Hemodynamic Collapse from Unintentional Ingestion of Hydroxychloroquine Prescribed for COVID-19

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**Background:** Hydroxychloroquine (HCQ) is an antimalarial and anti-inflammatory drug that causes sodium and potassium channel blockade. Overdose can cause hypokalemia, dysrhythmias, cardiovascular collapse, and death. Treatments have been extrapolated from literature on chloroquine toxicity, and include potassium repletion, high-dose diazepam, and early use of vasopressors.
**Methods:** This is a case report of a gentleman with a history of insulin-dependent diabetes mellitus who accidentally ingested five grams HCQ. He presented to the ED 20 minutes post-ingestion alert and normotensive. One hour post-ingestion, he developed lethargy and hypotension (66/46 mm Hg). Epinephrine (seven mcg/min) was started and he was intubated. High-dose diazepam was unavailable due to a national shortage; instead, continuous midazolam (two mg/hr) was given, along with sodium bicarbonate infusion for QRS widening to 125 ms (concomitant QTc 380 ms). At eight hours post-ingestion, he developed diabetic ketoacidosis (DKA) from self-discontinuation of his insulin pump requiring continuous insulin infusion.
**Results:** Bicarbonate drip was held at 12 hours post-ingestion due to hypokalemia (nadir 3.2 mmol/L), while midazolam and epinephrine were continued. QRS normalized (96 ms) 13.5 hours post ingestion, DKA resolved, and vasopressors were discontinued 24 hours post-ingestion. After extubation, the patient reported restarting an old HCQ prescription for upper respiratory symptoms. He mistakenly took the HCQ in place of his daily pills combined in a similar bottle. Plasma hydroxychloroquine level from 20 hours post-ingestion was 6200 ng/dL (reference peak: < 550 ng/dL).
**Conclusion:** This was a case of critical illness after unintentional HCQ overdose that highlights the dangers of inappropriate prescribing of ineffective drugs to treat COVID-19. Despite plasma levels consistent with other cases of severe toxicity, this patient improved quickly without recommended high-dose diazepam. Whether midazolam exerted the same purported synergism between high-dose diazepam and vasopressors, or whether vasopressors alone would have been sufficient is an avenue for future investigation.

## 167. Adverse Drug Events Associated with Remdesivir Among Hispanic Populations

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**Background:** Genetic differences in drug metabolism have been identified for many drugs among different races and ethnicities. Such altered metabolism may be responsible for different rates of adverse drug events (ADEs). It has been suggested that Hispanic individuals may have higher rates of ADEs related to remdesivir, although data supporting such a claim is lacking.
**Hypothesis:** This study attempted to evaluate if there are different rates of ADEs among Hispanic individuals receiving remdesivir compared to non-Hispanic individuals.
**Methods:** The FDA-ACMT Covid-19 ToxIC (FACT) pharmacovigilance project both retrospectively and prospectively entered possible ADEs related to prevention and treatment of Covid-19. A total of 17 hospitals submitted cases between 11/23/2020 through 9/30/2022. All cases of ADEs associated with remdesivir were examined. A risk ratio was calculated for cases of ADEs associated with remdesivir based on Hispanic or non-Hispanic ethnicity. Logistic regression was performed to adjust for sex and age.
**Results:** The median (IQR) age was 61 (49-71) years; 58% were male. 180 Hispanic individuals were identified in the cohort of ADEs. 543 ADEs reported with remdesivir, including 234 cases of bradycardia, and 171 cases of hepatotoxicity. After adjusting for age and sex, there was no difference in the rates of overall ADEs with remdesivir. Specifically, there were no differences in the overall rates of ADEs, nor was there any difference in the rates of bradycardia or hepatotoxicity in Hispanic individuals compared with non-Hispanic individuals.

**Conclusion:** This study did have several limitations, including possibly being under powered to detect subtle differences. Ethnicity reporting was based on retrospective review, with such inherent limitations, possibly resulting in misclassification. Nonetheless, in this series, there is no observed difference in the rates of ADEs associated with remdesivir among Hispanic individuals compared with non-Hispanic individuals.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 168. A Case Report of Venezuelan Suntiger Tarantula (*Psalmopoeus Irminia*) Envenomation

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**Background:** Toxicity from tarantula envenomation is rare. However, the rate of tarantula envenomations may increase as exotic animal ownership increases in the United States. This case report presents the first documented envenomation and toxicity from a Venezuelan suntiger tarantula (*Psalmopoeus irminia*).
**Case Report:** A 35-year-old male with prior renal cell carcinoma in remission presented to an emergency department four hours after being bitten by his pet Venezuelan suntiger tarantula on the left thenar eminence. He developed rapid onset of pain, erythema, and swelling along the radial hand and wrist. Over four hours, he developed diffuse abdominal pain, nausea, vomiting, throat itching, and tightness. The patient's vital signs included: BP 131/105, HR 102, 97.8°F, RR 20, and SpO2 94% on room air. Laboratory evaluations were within normal limits. The patient received 0.5 mg epinephrine intramuscularly (IM), 50 mg diphenhydramine intravenously (IV), 20 mg famotidine IV, 4 mg ondansetron IV, and 1 liter of normal saline for a suspected anaphylactic reaction. The patient's airway and gastrointestinal symptoms resolved. He was discharged home after an observation period. On follow-up, he reported the resolution of dermal symptoms after one week.
**Discussion:** Venezuelan suntiger tarantulas are native to Venezuela and Guyana and are identifiable by black coloration with orange leg markings and abdominal stripes. Tarantula toxicity occurs due to venom effect after a bite or exposure to urticating setae that induce an inflammatory reaction. However, this species is not known to release urticating hairs, unlike other non-*Psalmopoeus* New World tarantulas. While little is known of this species' venom, this patient developed symptoms consistent with and improved after treatment for an anaphylactic or anaphylactoid reaction, which has been reported in other tarantula species.
**Conclusion:** We report a case of Venezuelan suntiger tarantula envenomation resulting in an anaphylactoid reaction, the first to our knowledge.

### 169. Adverse Events in Pediatric Patients Treated with COVID-19 Therapeutics Reported to the FDA ACMT COVID-19 ToxIC (FACT) Pharmacovigilance Project

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**Background:** The COVID-19 pandemic prompted a surge in the development and repurposing of approved and unapproved therapeutics for the SARS-CoV-2 virus. Due to differences in physiology and risks, pediatric patients were often excluded from trials examining the safety of COVID-19 therapeutics. Despite the paucity of safety data, pediatric patients are often treated with COVID-19 therapeutics and are vulnerable to adverse events (AEs).
**Methods:** This is a case series of AEs in pediatric patients associated with COVID-19 therapeutics submitted to the FDA ACMT COVID-19 ToxIC (FACT) Pharmacovigilance Project between November 23, 2020, and September 21, 2022. FACT is an ongoing toxicosurveillance project at 17 sites focusing on identifying AEs to COVID-19 therapeutics. Cases are identified via site-specific mechanisms, including direct contact, provider or pharmacist referral, or chart review. The inclusion criteria in this subset analysis were patients under 18 years of age with a suspected AE after a COVID-19 therapeutic.
**Results:** Of the 1,072 cases reported to FACT during the study period, 27 (2.5%) cases were in pediatric patients. Patients' ages ranged from five months to 18 years with a median of 13 years (IQR 4-17). Seventy percent of patients had known or presumed COVID. The majority of AEs were in patients treated for COVID-19 with remdesivir, monoclonal antibodies, and vitamins. The most common AE was bradycardia (6 cases), five of which were associated with remdesivir (83%). However, patients developed a wide range of AEs.
**Conclusions:** Pediatric patients represent a high-risk group for AE from COVID-19 therapeutics as they are often

excluded from medical trials. This data displays AEs that occurred in pediatric patients exposed to COVID-19 therapeutics. Further study and analysis are needed to evaluate the effects of these therapies on pediatric patients. The FACT project is ongoing and will continue to identify AEs associated with COVID-19 therapeutics.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 170. Inverted Takotsubo Cardiomyopathy from a Weight Loss Supplement

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**Background:** At least 70% of Americans take some form of dietary supplement every day. Despite massive industry profit, supplements do not require FDA approval before being brought to market and instead rely on post-market reporting to monitor adverse events. Evidence demonstrating health benefits of supplements is limited in well-nourished adults, but substantial toxicity of some products has been reported.
**Case Report:** A 26-year-old female presented with chest pain and shortness of breath. Symptoms started after taking two 100 mg pills of the weight loss supplement Hydroxyelite. The patient was tachypneic in the emergency department with an electrocardiogram showing sinus tachycardia with ST-segment depressions in anterolateral leads. Troponin T was elevated to 0.749 ng/mL (ref < 0.03) and NT Pro-BNP was elevated to 12,325 ng/L (ref 5-450). Echocardiogram showed inverted takotsubo cardiomyopathy with a left ventricular ejection fraction of 20%. Substance analysis of the Hydroxyelite revealed Octodrine (DHMA), a CNS stimulant that increases dopamine and noradrenaline uptake, and yohimbine, an alpha-2-antagonist which increases circulating noradrenaline. Neither substance was listed on the label. After two hospital days on metoprolol and furosemide, the patient's LVEF normalized and her symptoms resolved.
**Results:** Inverted takotsubo cardiomyopathy is characterized by akinesis of the mid and basal LV segments with hyperdynamic apical motion. It is typically seen in younger patients and is thought to be from catecholamine-induced myocardial stunning. Animal studies of octodrine toxicity have shown adverse cardiac events but this effect has not been demonstrated in humans. Yohimbine has been associated with palpitations, tachycardia, and QT-prolongation in humans, but has never been associated with takotsubo cardiomyopathy.
**Conclusion:** Octodrine and yohimbine, unlisted ingredients in Hydroxyelite, may have resulted in catecholamine-mediated cardiac injury. The unregulated nature of the supplement industry potentiates toxicity risk without proven benefit to health. Caution should be employed when using these products.

### 171. Treatment with F(ab')2 (Anavip®) for Eastern Massasauga Rattlesnake Envenomation: A Case Report

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**Background:** The Eastern Massasauga rattlesnake is native to the Great Lakes region of North America. The two Food and Drug Administration (FDA)-approved antivenins to treat crotalid (Pit Viper) envenomation are FabAV (CroFab®) and F(ab')2 (Anavip®). All documented cases of antivenin administration for Eastern Massasauga bites have used FabAV, which is derived from North American crotalid species. It is not previously known if F(ab')2, derived from South American crotalid species, is safe and/or effective in Eastern Massasauga envenomations.
**Case Report:** A 33-year-old wilderness photographer in Michigan was bitten on the right leg by an Eastern Massasauga rattlesnake resulting in local inflammation, nausea, diaphoresis, and typical hematologic abnormalities. Transfer to a tertiary center and patient hesitancy delayed initial administration of antivenin to 7.5 hours post-envenomation. F(ab')2 was selected for use due to availability. Control was not achieved after the first 10 vials, as INR increased from 1.9 to 2.3, and local tissue effects were progressive. After an additional 10 vials, INR decreased (1.4), but fibrinogen reached a critically low level of 69 mg/dL (from 232). Ultimately, a total of 34 vials of F(ab')2 were administered over the two day hospital course to achieve normalization of all lab values and symptoms. No adverse reactions occurred.
**Discussion:** The patient in this case required 34 vials of F(ab')2, compared with previous data which show a median requirement of 20 vials to achieve control in crotalid envenomation. The increased dose may be secondary to differences in regional snake species used in antivenin production. It could also be due to delayed treatment time from initial presentation.
**Conclusion:** F(ab')2 is likely safe, but potentially less effective, than FabAV when used in Eastern Massasauga rattlesnake envenomations.

## 172. Pharmacogenetic Evaluation Of Adverse Drug Reaction To Carvedilol

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**Background:** Pharmacogenetic testing is increasingly used to predict clinical responses to medications. Prior studies demonstrate genetic variability in the CYP2D6 enzyme which may affect drug levels of carvedilol. Pharmacogenetic testing aided the diagnosis of carvedilol toxicity in this patient.
**Case report:** A 48-year-old man with hypertension, hyperlipidemia, bipolar disorder, and a previous stroke, presented to a community emergency department after being found unresponsive with blood pressure of 96/63 mmHg and a heart rate of 34 beats/minute. Initial EKG showed sinus bradycardia at 34 beats/minute without AV nodal block or ischemia. Head CT was unremarkable. Initial labs showed mild metabolic acidosis and a negative troponin. He was intubated, started on norepinephrine, and transcutaneously paced with capture and improved blood pressure. On arrival at our center, he was evaluated by electrophysiology and toxicology services, both having concerns for a toxic etiology given lack of conduction abnormalities on EKG. Pacing was discontinued, and epinephrine and dopamine were initiated. His hypotension and bradycardia resolved over the next 24 hours, and the vasopressors were weaned and discontinued. He was extubated on hospital day two, and discharged on hospital day six. Further history revealed that he had recently been switched from metoprolol to carvedilol 25 mg 3 times daily, with dose reduction to twice daily 1 week prior. Patient and family denied overdose, and his individually wrapped medications were accounted for. Given the severe toxicity without history of overdose, pharmacogenetic testing was sent to evaluate for impaired p450 function. Results showed the patient to have poor function of 3A5 and intermediate function of 2C9, 2D6, and 3A4. On discharge, his carvedilol dose was decreased to 12.5 mg twice daily and his fluoxetine was discontinued.
**Conclusion:** Carvedilol adverse drug reaction was due to a combination of drug-drug and gene-drug interactions. Pharmacogenomic testing resulted in recommendations for safer medication management.

## 173. Toxicology Two-Face – Unilateral Phytophotodermatitis after Ingestion of Chlorella Algae and Exposure to Red Light Therapy

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**Background:** Chlorella is a green microalga sold as a nutritional supplement and has been implicated in photosensitization. Red light therapy provided by commercially available lamps produces specific frequencies of red and near-infrared light and is purported to improve skin appearance. We present a patient who developed unilateral facial swelling after chlorella ingestion followed by red light therapy.
**Case report:** A 41-year-old man presented to the emergency department with left-sided facial swelling. Three days prior to the presentation, he consumed an entire package (~2000) of 250 mg chlorella tablets as a snack. One day prior, he used a red light therapy lamp directed to his left face for 30 minutes. Four hours later, the patient noticed slight swelling on the left side of his face which progressed over approximately 12 hours and was associated with erythema and mild stinging (photos available). He had no other associated symptoms or other new exposures. Results of a complete blood count and basic metabolic panel were within normal limits. A CT of the head and neck showed nonspecific soft tissue edema. The patient was treated with diphenhydramine, loratadine, and prednisone. After evaluation by medical toxicology and dermatology, both services agreed on the diagnosis of phytophotodermatitis. Patient was observed overnight and discharged the next morning. His facial swelling steadily improved and had almost resolved after two days.
**Conclusion:** Ingestion of chlorella has been associated with the development of phytophotodermatitis, which can be delayed. The causative agent is thought to be pheophorbide-a, a chlorophyll breakdown product. Our patient likely had this reaction accelerated by red-light therapy. Phytophotodermatitis has been previously reported with use of ultraviolet phototherapy but to our knowledge this is the first report of its development after red light therapy.

### 174. Saw Scale Viper (Echis carinatus sochureki) Envenomation Successfully Treated with Inoserp© MENA, and Experience with the AZA Antivenom Index

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**Background:** Envenomation by non-native snake species can pose clinical and logistical challenges to clinicians when selecting and procuring antivenom. We present a case of an exotic snake envenomation successfully treated with antivenom, and our experience with the Antivenom Index.
**Case Report:** A healthy 25-year-old man presented to the Emergency Department immediately after an envenomation to his left middle finger by his own saw scale viper (Echis carinatus sochureki). On arrival, the patient had a puncture wound with minimal ecchymosis and pain. The patient had sustained tachycardia in the low 100's but otherwise normal vital signs. Labs were notable for INR 1.33 and fibrinogen 46 mg/dL. Utilizing the Association of Zoos and Aquariums (AZA) Antivenom Index (AI) we found availability of antivenom from several facilities located numerous states away. Unfortunately, this could not be procured within 24 hours due to transportation issues. We obtained Inoserp© MENA from one state away. This product was listed by the AI as "NOT indicated for this species in the package insert, but other species in this genus are." The antivenom was transported by highway patrol relay across the state line, then by air ambulance to our facility. Due to persistently low fibrinogen between 34-55 mg/dL and coagulopathy, we administered two vials of antivenom 12 hours after arrival without complication. His fibrinogen began to increase about 30 minutes after administration. The patient was observed for a total of 40 hours after presentation and did not develop thrombocytopenia or significant local tissue injury.
**Conclusions:** We present a case of a saw scale viper envenomation successfully treated with Inoserp© MENA antivenom procured with the assistance of the AI. Clinicians should be aware that logistical issues can significantly delay treatment of non-native snake envenomation and they may need to prioritize geographical proximity when using the AI.

### 175. Characteristics of Crotalid Venom-Induced Neurotoxicity in the North American Snakebite Registry (NASBR)

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**Background:** Although famously associated with the Mojave rattlesnake, neurotoxicity may occur after envenomation by many crotalid species. The frequency of specific venom-induced neurotoxic effects is not well described.
**Research Question:** What are patient demographics, clinical findings, and treatments associated with venom-induced neurotoxicity in the NASBR?
**Methods:** This is an analysis of prospectively collected data from patients with neurotoxicity after snake envenomations reported to the NASBR spanning 2013-2021. Neurotoxicity was defined as fasciculations, myokymia, paresthesias, altered mental status, or respiratory failure. Cases were excluded for involving non-Crotalus or non-native species, having isolated subjective paresthesias, or no description of neurotoxicity. Data collected included demographics, envenomation characteristics, and treatment information.
**Results:** Ninety-two cases with neurotoxicity were reported. 49 were excluded for isolated subjective paresthesias or no data. 43 were included. The majority ($N = 32$, 74%) were from California, followed by Arizona ($N = 7$, 16%). Of the identified species ($N = 16$), the Southern Pacific rattlesnake was most common ($N = 7$, 44%). Zero non-rattlesnake crotalid cases reported objective neurotoxicity. Most cases ($N = 28$, 65%) involved adults 18-65; most were male ($N = 31$, 72%). Most bites were to the lower extremity ($N = 26$, 60%), mostly to the lower leg ($N = 9$, 35%). Fasciculations/myokymia were the most common finding ($N = 37$, 86%), followed by paresthesias ($N = 26$, 60%), weakness ($N = 7$, 16%), and altered mentation ($N = 6$, 14%). Three cases with intubation were reported: two from California, one from Arizona, all species unknown. Neurotoxicity resolution was temporally associated with antivenom administration in 89% of cases ($N = 16$) in which response to antivenom was reported ($N = 18$); 56% ($N = 9$) of these cases received Fab alone, 19% ($N = 3$) received Fab2 alone, and 25% ($N = 4$) received both.
**Conclusion:** Most cases of neurotoxicity occurred after rattlesnake envenomation in California, where both the Southern Pacific and Mojave species are found. Fasciculations were the most common objective effect reported and there were three cases requiring intubation.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 176. Kunene Coral Snake Envenomation: A Lesson in Rare Snake Bites

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**Background:** The Kunene coral snake (*Aspidelaps lubricus cowlesi)* is a venomous snake belonging to the Elapidae family and is native throughout Namibia and into Angola. Little is known about the effects of the Kunene coral snake's venom and there is no known antivenom. While neurotoxic envenomation by the related Cape coral snake (*Aspidelaps lubricus lubricus*) has been reported, little is known about Kunene coral snake envenomation.
**Hypothesis:** Kunene coral snake envenomation may present with neurotoxic symptoms and anaphylaxis.
**Methods:** This is a single patient case report. A 38-year-old male was handling a juvenile Kunene coral snake at a local snake show, when he was suddenly bitten on the left posterior distal forearm. Approximately one minute after being bitten, he experienced nausea, vomiting, palpitations, and then had an episode of syncope for which emergency medical services was called. He was initially hypotensive to 50 mmHg systolic and hypoxic to 89% on room air and was transferred to the local emergency department. Shortly thereafter, he experienced facial paresthesia and hives. He was treated with oxygen, intramuscular epinephrine, diphenhydramine, and dexamethasone for anaphylaxis. There was no notable swelling or erythema around the bite wound. He was found to have a negative inspiratory force (NIF) of -40 cm H2O. Coagulation profile and platelets were within normal limits. The patient was then transferred to the tertiary care center.
**Results:** Upon arrival at the tertiary care center, the patient's paresthesias and hemodynamic instability had resolved. He was found to have a NIF of -60 cm H2O and a vital capacity of 4 liters. A repeat coagulation profile was within normal limits. Despite recommendations for continued observation for delayed neurotoxicity, the patient left the hospital against medical advice.
**Conclusion:** Kunene coral snake envenomation may result in anaphylaxis and neurotoxicity.

### 177. Pediatric *Sistrurus miliarius streckeri* Envenomation with Bruising and Erythema Successfully Treated Early with Fab

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**Background:** In the USA, the smallest of the rattlesnakes are the "pygmy" group with few documented envenomations. Their venom potency can be underestimated and when treated late can result in significant morbidity. We present a moderate pediatric envenomation with progressive bruising successfully treated early with Fab antivenom (FabAV).
**Methods:** This is a single case report. A seven-year-old boy with no prior medical history sustained an unknown snakebite of the left foot. He was taken to a rural facility where he was flown to our satellite hospital. There he had nausea, swelling, and pain. The hospital contacted poison control for consultation with our toxicologist who recommended antivenom and transferring to the main campus. Labs obtained five hours after the bite displayed normal platelets, PT/INR, and fibrinogen. He received morphine for pain and four vials of FabAV. The patient's family brought in the snake, and it was photo confirmed to be a western pygmy rattlesnake. He was admitted to the pediatric intensive care unit where an additional six vials FabAV were given over 18h. Patient continued to have swelling of the leg with progressive bruising and briefly an erythematous rash of the shin. His INR peaked at 1.1, with platelets nadir 193,000. He was discharged home on hospital day four after swelling/color changes stabilized.
**Results:** Western pygmy rattlesnakes (*Sistrurus miliarius streckeri*) are native to the southeastern US. They are small even when fully grown, reaching just under two feet. Their rarity is likely due to their size and secluded nature. Our case demonstrates that they have potent hemotoxic venom for their size and can present with progressive bruising and skin discolorations that do respond to FabAV.
**Conclusion:** *Sistrurus miliarius* envenomations are a rare occurrence that can be underestimated on presentation but develop moderate pain/swelling that is responsive to FabAV.

## 178. Measurement of the Oligosaccharide Galactose-α-1, 3-Galactose (α-Gal) in Pit Viper Antivenom

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**Background:** The presence of α-gal in mammalian products and certain drugs has been known to cause an allergic reaction in patients with α-gal syndrome. Previously published work concluded that α-gal was detected in the ovine-derived Fab antivenom Crotalidae Polyvalent Immune Fab (Ovine).
**Hypothesis:** The current study aims to confirm these findings and attempt to quantify α-gal in both ovine Fab antivenom and the equine-derived F(ab')2 antivenom Crotalidae Immune F(ab')2 (Equine).
**Methods:** Western blot analyses were undertaken using a mouse antibody specific to α-gal, followed by confirmatory quantitative analyses using the Protein Simple Jess Western Blot system which automates the western blot via capillary-based size separation. A control ovine Fab product and cetuximab, a well-known commercial monoclonal antibody known to carry α-gal, were included in the evaluation as additional comparators.
**Results:** Ovine Fab, a control ovine Fab and equine F(ab')2 at a concentration of 1mg/mL were run in duplicate alongside cetuximab at 1 mg/ml and 0.25 mg/ml using Western blot analysis; findings established the presence of α-gal in ovine Fab, equine F(ab')2 and cetuximab. Ovine Fab and Equine F(ab')2 samples were then diluted to 0.4 mg/ml, and the cetuximab to 0.1 mg/ml and analysis was conducted using the Jess Simple Western system. Results confirmed the previous Western blot analysis, and showed that the levels of α-gal present in ovine Fab was three-fold lower than the levels observed in the equine F(ab')2 product.
**Conclusion:** Analysis by Western blot established that there is α-gal present in both ovine Fab and equine F(ab')2 antivenoms. Analysis by the Protein Simple Jess system confirmed these findings and showed that the relative ratio of α-gal in equine F(ab')2 appears to have three times as much α-gal as the ovine Fab product.

## 179. Accuracy of Snake Identifications by Nonexperts Using Social Media

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**Background:** Approximately 82% of U.S. adults use social media. A previous study demonstrated that online snake-themed group moderators provide correct snake identifications. However, people may be unaware of these groups and instead rely on laypeople in their local community pages. The purpose of the study was to determine whether non-experts in these neighborhood-based groups could provide accurate identifications.
**Methods**: We searched multiple community-based groups on Facebook™ and in the Nextdoor™ app in four regions: Georgia, Texas, Kentucky, and Missouri. There were 90 snake photos (79 nonvenomous, 11 venomous) submitted for identification between December 2015 and June 2021.
**Results**: There were 949 total snake identifications. Overall accuracy was 66.8%. Venomous and nonvenomous snakes were correctly identified 78.3% and 64.1% of the time, respectively. Among nonvenomous snakes, watersnakes (Nerodia spp.) were frequently misidentified, with an overall accuracy of 49.8%. Respondents were slightly better with racers/coachwhips (Coluber) and ratsnakes (Pantherophis), for which correct identifications were provided 65% and 69.3% of the time, respectively. Kingsnakes/milksnakes (Lampropeltis) were identified correctly 78.3% of the time, while garter snakes (Thamnophis) and hognose (Heterodon) identifications were accurate 80% and 81.3%, respectively. As for venomous snakes, 84% of eastern copperhead (Agkistrodon contortrix) and 73% of northern cottonmouth (Agkistrodon piscivorus) identifications were correct. Rattlesnakes (Crotalus spp.) were correctly identified 76% of the time. False positive (type I) errors, in which a nonvenomous snake was identified as venomous, occurred in 41 (5.4%) of 765 cases. False negative (type II) errors, in which a venomous snake was labeled as nonvenomous, occurred in 21 (11.4%) of 184 identifications.
**Conclusions**: Our data demonstrate that nonexperts cannot reliably identify snakes. Furthermore, Type II errors could result in serious harm to people who do not realize they have encountered a venomous snake. The public should be encouraged to consult snake experts to provide correct identifications.

## 180. Captive Black Mamba (*Dendroaspis polylepis*) Bite Leading to Respiratory Failure

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**Background:** Of the 8,000-10,000 snake envenomations evaluated in U.S. emergency departments (ED) annually, approximately 1% are due to non-native snakes. We describe a 26-year-old male who was bitten by his captive black mamba (*Dendroaspis polylepis*) as he was packing it up for transport to another snake collector.
**Case Report:** The patient presented to the ED one hour after being bitten on the forearm complaining of left arm pain, oral paresthesias, and dyspnea. His vital signs: heart rate 96 beats/min, blood pressure 167/101 mm Hg, temperature 36.7° C (97.9° F), respiratory rate 20 breaths/min, and room air oxygen saturation 100%. Two mildly tender puncture wounds without swelling or ecchymosis were found on the posterior aspect of the forearm. Over the ensuing 30 minutes his dyspnea worsened, and he developed objective weakness. He was intubated and placed on mechanical ventilation. He was treated with atropine 2 mg for bronchorrhea. Five vials of South African Vaccine Producers (SAVP) polyvalent antivenom were administered 2.5 hours post-bite and the patient was admitted to the intensive care unit. He was extubated 18 hours post-envenomation and discharged the following day. He has remained asymptomatic since leaving the hospital.
**Discussion:** The primary manifestations of *D. polylepis* envenomings are neurological. Initial signs may include paresthesias, dysarthria, dysphagia, and ptosis. Progressive descending paralysis leading to respiratory failure develops within 60 minutes. Muscarinic features are frequently observed. Cardiotoxicity and hematologic laboratory abnormalities may be present. Although pain is common, significant local tissue injury does not occur. In addition to supportive care, several non-native antivenoms are indicated for *D. polylepis* envenomations.
**Conclusion:** Black mamba envenomings differ from the native snakebites with which U.S. physicians are familiar. Rapid, progressive neurological toxicity and muscarinic features are most common. Treatment consists of supportive care and appropriate antivenom administration.

### 181. "Harmless" Snake Envenomation: Prolonged Bite from *Thamnophis rufipunctatus* Resulting in Clinically Significant Injury

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**Background**: Generally considered non-venomous, colubrid snakes do produce myotoxic and hemotoxic factors in their Duvernoy's glands. Due to a rear-fanged venom delivery system, clinically significant envenomations in humans are rare.
**Methods**: This is a single patient case presentation managed directly by the authors. A 7-year-old boy with no past medical history presented to an outside hospital after a snake bite. The snake remained attached to his left hand for approximately 10 minutes. Twelve hours after envenomation, the patient complained of pain and swelling and was brought to an emergency department for evaluation. The snake was described as "non-venomous" by the family, and the patient was discharged home. Twenty-four hours after the bite, he returned due to increased swelling. Exam revealed proximal extension of the envenomation with marked swelling and ecchymosis over the dorsal and ventral aspects of his hand extending to his forearm, with his fingers held in slight flexion. An abrasion to the dorsal aspect of his hand where the snake bit him was noted but did not appear infected. Due to concern for misidentification of the snake, the PCC recommended treatment with 10 vials of Anavip and transfer to the PICU for management.
**Results**: The swelling and bruising improved after the antivenom. His left extremity was splinted and elevated, and he was discharged after a 12-hour observation period. The species of snake was confirmed by a herpetologist as a narrow-headed garter snake (*Thamnophis rufipunctatus*) based on images provided by the family. At follow-up two days later, his edema and ecchymosis had continued to improve with no signs of infection. The patient never demonstrated hemotoxicity on labs drawn throughout all three presentations.
**Conclusion**: Prolonged bites from "non-venomous" colubrids can expose tissues to secretions of Duvernoy's glands which can result in local myotoxic effects which are clinically similar to crotalid envenomation.

### 182. Cardiac Arrest Following Voluntary Envenomation with Phyllomedusa Bicolor Secretions in Kambô Ritual

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**Background:** Kambô is a medicinal and purification ritual performed in South America that involves voluntary envenomation with the secretions of Phyllomedusa bicolor, the giant tree frog. The secretions contain numerous bioactive peptides and are administered transdermally through extremity skin wounds created by the burns of a hot stick. Case reports describe adverse outcomes following these rituals, including cardiac arrhythmias, psychosis, and death. We

describe a case of presumed respiratory and subsequent cardiac arrest following a Kambô ritual.
**Methods/Results:** A 43-year-old man with a history of asthma presented to our emergency department (ED) after cardiac arrest. Per report, the patient had performed the Kambô ritual just hours prior. He became dyspneic and used his inhaler without relief. His symptoms progressed and on paramedic arrival, he was obtunded and bradycardic, then went into pulseless electrical activity. Cardiopulmonary resuscitation was performed, and he regained pulses prior to ED arrival. In the ED, he was emergently intubated. He was hypotensive, wheezing, and developed worsening myoclonic jerks. He was treated with norepinephrine, albuterol, ipratropium, dexamethasone, magnesium, and levetiracetam, and was admitted to the intensive care unit (ICU). Cardiac catheterization was unremarkable. Imaging of the brain showed evidence of hypoxic ischemic injury with edema and herniation, and the patient was ultimately declared brain dead.
**Conclusion:** The bioactive peptides of the secretions used in Kambô and their effects include phyllocaerulein (hypotension), phyllomedusin (behavioral responses, smooth muscle contraction, vasodilation), dermorphins and deltorphins (opiate-like effects), and phyllokinin (targets bradykinin receptors). Given that the patient had a history of severe asthma requiring ICU admissions and intubations, we hypothesize that the recent Kambô ritual may have caused bronchoconstriction due to bradykinin-like effects and precipitated a severe asthma exacerbation leading to respiratory and subsequent hypoxic cardiac arrest. Toxicologists should be aware of the Kambô ritual and its potential adverse effects.

### 183. Assessing the Accuracy of Venomous Versus Nonvenomous Snake Identification By Emergency Physicians

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**Background:** Approximately 9,000 snake bites occur in the United States annually, with the majority initially assessed by emergency physicians. Patients often bring a picture, or the actual snake, to the emergency department. Misidentification of the snake may lead to the mistreatment of snakebite patients. Currently, there is limited data on the accuracy of the identification of snakes by emergency physicians.
**Research Question:** What percentage of emergency physicians can accurately identify a venomous versus a nonvenomous snake?
**Methods:** A 61-question survey was approved by the Western IRB. Surveys were distributed either online or through residency listservs. The survey included demographic questions followed by 25 pictures of snakes. Each picture asked a "yes/no" question of "Is this snake venomous", followed by an open question of species identification. All answers were inputted into a spreadsheet and analyzed.
**Results:** Two-hundred forty-eight emergency physicians responded. The majority were attendings ($n = 211$, 85.1%), followed by fellows ($n = 10$, 4.0%), or residents ($n = 27$, 10.8%). Fifty-four (21.8%) completed a fellowship, with medical toxicology ($n = 11$, 4.4%) and pediatric emergency medicine ($n = 9$, 3.6%) being the most common. The mean confidence of identifying a venomous snake was 4.22 on a 1 to 10 Likert-type scale. Most respondents treat less than 2 envenomations per year ($n = 193$, 77.8%). Overall, respondents were correct 79.8% when answering "yes/no " if a snake was venomous. They were correct 24.5% of the time when asked to identify the specific species. Venomous snakes were misidentified as "non venomous" 25.1% of the time. There was a moderate correlation ($R2 = 0.48$) between self-reported confidence of identifying a snake as venomous and correct identification.
**Conclusion:** Emergency physicians appropriately identify snakes as venomous or nonvenomous a majority of the time. There remains concern that almost a quarter of responses regarding venomous snakes were misidentified as nonvenomous, which can lead to a failure to treat.

### 184. Leaving on a Jet Plane: Severe Neurotoxicity in an Adult Stung by a *Centruroides* Scorpion in El Salvador Presenting to a US Emergency Department

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**Background:** Scorpions of the genus *Centruroides* are found primarily in the southwestern United States (U.S.), Mexico, and Central America. Their venom contains neurotoxins that target voltage-sensitive sodium channels, resulting in repetitive nerve depolarization. Clinical manifestations of *Centruroides* envenomation can range from local pain and/or paresthesias (Grade I) to cranial nerve dysfunction and/or

skeletal neuromuscular dysfunction (Grade III or IV). Most cases of severe envenomation involve children. We report an usual case of severe neurotoxicity in an adult following envenomation by a scorpion in El Salvador that presented to a U.S. emergency department (ED).

**Case Report:** A 66-year-old female presented to a community ED with inability to ambulate. 24 hours prior she reports being stung on her right 5th digit by a scorpion in her home in El Salvador. She developed immediate severe pain followed by paresthesias extending up her arm. Three hours later she developed difficulty swallowing, facial swelling, and oral numbness. Symptoms progressed to include chest tightness, dysmetria, ataxia, restlessness, and inability to ambulate. The following morning she boarded a previously-scheduled flight to Los Angeles, and then proceeded directly to a local ED. Upon arrival she had dysmetria and remained unable to ambulate due to ataxia and 4/5 strength. She was transferred to a tertiary hospital for toxicology evaluation, where she arrived 36 hours after the sting. At that time, her ataxia had resolved and her only remaining symptoms were pulsatile pain and arm numbness. The scorpion was presumptively identified by a scorpion expert as a female *Centruroides exilimanus*.

**Conclusions:** Prolonged neurotoxicity consistent with grade IV envenomation can occur in adults following envenomation with Central American *Centruroide*s species, presumed to be *C. exilimanus*. Envenomations from *C. exilimanus* have not been previously described. Given the ease of air travel, these patients may seek medical care in the U.S.

## 185. Safe Administration of Crotalidae Immune F(ab')$_2$ Antivenom in a Patient with Anaphylactic Reaction to Crotalidae Polyvalent Immune Fab Antivenom

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**Background**: Patients that suffer envenomation from North American Crotalids can be treated with Crotalidae immune F(ab')$_2$ (Anavip®) or Crotalidae polyvalent immune Fab (Crofab®). It is unknown whether there is cross-reactivity in patients who suffer anaphylactic reaction from one antivenom.

**Hypothesis**: Because of manufacturing and antibody fragment differences, patients with an allergy to one antivenom may tolerate the other antivenom without significant cross-reactivity.

**Methods**: This is a case report of A 62-year-old man with history of factor V Leiden deficiency with pulmonary embolism on apixaban, Parkinson's disease, hypertension, and COPD who presented with an Agkistrodon contortrix (Copperhead) envenomation.

**Results**: The patient was bitten on his left forearm by a Copperhead snake. He experienced swelling and pain within 1 hour. His physical exam was notable for severe pain and soft tissue swelling, extending from the forearm to shoulder. Laboratory studies revealed a platelet count of 165 x 103/mm3, fibrinogen level 250.0 mg/dL, PT/INR 11.0 seconds/INR 1.0, PTT 29.3 seconds. He had a history of an anaphylactic reaction to Crofab® which was the only antivenom initially available. He was pre-treated with diphenhydramine and famotidine prior to initiation of Crofab®, but still developed anaphylactic reaction symptoms. The infusion was stopped, and the patient was administered 125 mg methylprednisolone. He was then transported to our tertiary care facility after his reaction was resolved. We administered Anavip® with improvement in his pain and swelling without any allergic symptoms or side effects. He was safely discharged the next day.

**Conclusion**: In this case, a patient with anaphylaxis to Crofab® despite pre-treatment was safely treated with Anavip® without any evidence of allergic response and with improvement in envenomation symptoms. Because of differences in manufacturing and antibody fragment differences, patients with a history of anaphylaxis to Crofab® may be safely treated with Anavip®.

## 186. Recurrent Venom Induced Consumptive Coagulopathy Despite FAB and FAB2 Antivenom Therapy in a Suspected *Crotalus Horridus* Envenomation

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**Background:** Recurrent venom-induced consumptive coagulopathy (VICC) from *Crotalinae* envenomation may occur despite antivenom therapy and has been observed as late as two weeks following envenomation. Crotalidae-immune-Fab'2-equine (FAB2) has demonstrated control of late venom effects given its longer half-life. However, limited cases describing multiple doses of FAB2 to treat recurrent VICC exist.

**Methods:** A 42-year old female presented after envenomation to her right ankle by an unknown rattlesnake, but from an area endemic to *Crotalus horridus*. Swelling progressed rapidly, requiring two doses of crotalidae-polyvalent-immune-fab-ovine (FABO) 4 vials to achieve initial control. Laboratory values were within normal limits (platelet

160 x 10^3/cmm, INR 1.3, fibrinogen 142.0 mg/dL, CK 146 units/L); maintenance dosing was initiated. By hospital day three (~24 hours after last FABO dose), the patient had developed oliguric renal failure secondary to rhabdomyolysis and on day four exhibited severe coagulopathy (fibrinogen <50 mg/dL, INR >10, platelet 76 x10^3/cmm), prompting more FABO. Coagulopathy persisted on day five and she was transferred to a tertiary care center, where FAB2 10 vials was administered. Renal function and coagulopathy immediately improved; however, her VICC subsequently recurred necessitating two doses of FAB2 four vials on days eight (fibrinogen < 50 mg/dL, INR 5.02) and 13. Fibrinogen and INR normalized at discharge.

**Discussion:** A 2015 study reported FAB2 had a lower incidence of recurrent coagulopathy when compared to FABO. Notably, no patients receiving FAB2 had a fibrinogen <60 mg/dL or platelet <50 x10^3/cmm. Our case is unique as severe VICC persisted despite multiple doses of both FABO and FAB2. Limited data exists regarding management of patients with persistent VICC who receive both antivenoms.

**Conclusion:** Recurrent VICC is a challenging complication of rattlesnake envenomation that can occur despite antivenom therapy. Even with the longer-acting antivenom, recrudescence of VICC may require additional FAB2 doses.

## 187. Efficacy of Crotalidae Immune F(ab')2 [equine] (F(ab')2) Antivenom in Agkistrodon Species: a Case Series

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**Background:** Recently crotalidae immune F(ab')2 [equine] (F(ab')2) antivenom was approved for use in envenomations by Agkistrodon species. The efficacy of F(ab')2 in these largely cytotoxic snakes is unknown, as clinical trials primarily evaluated hemotoxicity in rattlesnakes. This is a case-series of three patients with Agkistrodon envenomation requiring re-dosing of antivenom to obtain control of symptoms.

**Methods:** Agkistrodon envenomations reported to a single poison center in 2021 were manually reviewed for instances of progression of tissue edema despite early F(ab')2 administration.

**Results:** Of 27 Agkistrodon envenomations which received F(ab')2, three required re-dosing. Case one: A 13-year-old male with envenomation to the right middle finger received 10 vials of F(ab')2 two hours post-envenomation for edema extending to the mid-hand. Four hours later, edema had progressed to the elbow. Four vials of crotalidae polyvalent immune fab-ovine (FAB) were administered with stabilization. Case two: A 28-year-old male received 10 vials of F(ab')2 within one hour of envenomation to the second digit of the left hand. One hour later, ten additional vials of F(ab')2 were required due to rapid progression of edema to the elbow. Case three: A 31-year-old male received 10 vials of F(ab')2 two hours post-envenomation to the right index finger, with edema extending to the wrist. Six hours later, an additional 10 vials were administered, for extension to the elbow. Edema progressed to the bicep over the next 13 hours before successful control with six vials of FAB, instead. All patients remained hemodynamically stable with normal laboratory values while hospitalized.

**Conclusion:** In our experience, control of cytotoxicity using F(ab')2 is difficult in some Agkistrodon envenomations. However further study is needed to determine the relative efficacy of F(ab')2 in Agkistrodon envenomations.

## 188. Latrodectus Envenomations in Adult Patients: a Review of the Toxicology Investigators Consortium (ToxIC)

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**Background:** North America has five medically relevant spider species from the genus Latrodectus, commonly known as widow spiders. Widow spider venom is complex and contains a variety of neurotoxins. Signs and symptoms of envenomation range from localized pain to severe systemic symptoms, including vital sign abnormalities, muscle cramps, vomiting, and in rare cases respiratory distress and myocardial infarction. While an antivenin exists, care is typically supportive and data for pharmacological therapies is limited.

**Methods:** This is a retrospective review of the Toxicology Investigators Consortium (ToxIC) registry from January 2010 to September 2022 including all patients 19 years of age or older seen at bedside by a medical toxicologist and determined to have widow spider envenomation. Statistics are descriptive.

**Results:** A total of 48 cases were reported. Vital sign abnormalities were uncommon with five patients (10%) experiencing hypertension (SBP > 200 mmHg) and 5 experiencing tachycardia (HR>140). No other cardiovascular effects were reported. Neurological disturbances were most common with 11/48 (23%) patients experiencing symptoms. The most common nervous system effects were paresthesias

(5/48, 10%) and agitation (3/48, 6%). Dermatologic complications were relatively common with 11/48 (23%) of patients experiencing rash. Two patients (4.2%) experienced acute respiratory distress syndrome/asthma symptoms. Opioids were the most common class of medication given with 22/48 (46%) patients receiving them, followed by benzodiazepines in 19/48 (40%) patients. Antivenin was given in 11/48 (23%) patients. No deaths occurred.

**Discussion:** In this retrospective review, we found that the most common symptoms of widow envenomation in adults were pain, indicated by opioid administration in 46% of cases, followed by rash and neurological disturbances. Less than 25% of patients required antivenin administration. No deaths were reported, indicating that supportive care is adequate in most cases.

**Conclusion:** While symptoms can be severe, most cases of Latrodectus envenomation can be managed with supportive care.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 189. Latrodectus Envenomations in Pediatric Patients: a Review of the Toxicology Investigators Consortium (ToxIC)

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*[1]University of Kansas Medical Center, Kansas City, KS, USA. [2]Kansas Poison Control Center, Kansas City, KS, USA*

**Background:** North America has five medically relevant spider species from the genus latrodectus, commonly referred to as widow spiders. Widow spider venom is complex and contains a variety of neurotoxins. Signs and symptoms of envenomation can range from localized pain to severe systemic symptoms including vital sign abnormalities, muscle cramps, vomiting, and in rare cases respiratory distress and myocardial infarction. While an antivenin exists, care is typically supportive and data for pharmacological therapies is limited.

**Methods:** This is a retrospective review of the Toxicology Investigators Consortium (ToxIC) registry from January 2010-September 2022 and included all patients 18 years of age or younger seen at the bedside by a medical toxicologist and determined to have widow spider envenomation. Statistics are descriptive.

**Results:** Twenty-eight pediatric envenomations were identified, with a mean age of 8.4 years. Six patients experienced tachycardia (HR >140) and two patients experienced significant hypertension (SBP > 200 mmHg). No other significant vital sign abnormalities were documented. The most common symptoms documented were neurological in origin with agitation ($n = 6$) being the most common. Two patients experienced parasthesias and one patient had myoclonus. Dermatological manifestations were also documented with five patients experiencing a rash. The most common pharmacologic class used was opioids in 16 patients, followed by benzodiazepines in 11 patients. In total, nine patients received antivenin. There were no deaths in the dataset.

**Discussion:** Widow spider envenomations are relatively rare events, however symptoms can be severe. In our dataset there were no deaths and only 9/28 patients required antivenin administration. This is consistent with previous literature indicating deaths are rare and that supportive care is the mainstay of treatment.

**Conclusion:** Pediatric patients envenomated by widow spiders do well with supportive care. While some may require antivenin administration, deaths are uncommon.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium**

### 190. Pediatric Loxoscelism: a Review of Brown Recluse Bites in the Toxicology Investigators Consortium (ToxIC)

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**Background:** The brown recluse spider (*Loxosceles reclusa*) is one of the few medically relevant spider envenomations in North America. Local effects can include necrosis and blistering, while systemic effects can include fevers, rash, transaminase elevation, and hemolysis. For unclear reasons, systemic loxoscelism is more commonly reported in pediatric patients than adults. No antivenin is currently approved in the US, and data to support pharmacologic therapies are limited.

**Methods:** This is a retrospective review of the Toxicology Investigators Consortium (ToxIC) registry from January 2010-September 2022 including all patients 0-18 years of age seen at the bedside by a medical toxicologist and determined to have loxosceles envenomation. Statistics are descriptive.

**Results:** One hundred ninety-two cases were analyzed with an average age of 10.8 years. Dermatologic manifestations were common with 129/192 (67%) patients experiencing rash, 76/192 (40%) experiencing necrosis, and 66/192 (34%) experiencing blistering. Hemolysis occurred in 60/192

(31%) envenomations, with 29/60 (48%) receiving steroids and 24/60 (40%) requiring transfusion. Of 124 patients with known race data, 20/37 (54%) of Black/African patients experienced hemolysis versus 17/87 (20%) from other race categories. Fourteen (38%) Black/African patients experienced rash versus 11/87 (13%) from other race categories. Other hematologic abnormalities were uncommon. Common medications administered to patients included steroids (48/192) and opioids (20/192). Only one death occurred.
**Discussion:** Our data indicates that with appropriate supportive care, death from brown recluse envenomation is uncommon. The most common manifestations are dermatologic and hemolytic, and the most common treatments are steroids and blood transfusion. Interestingly, our data support anecdotal evidence that patients of Black/African descent have more severe responses to envenomation.
**Conclusion:** Rash and hemolysis are common manifestations of loxoscelism and toxicologists typically treat these with transfusions and/or steroids. Patients of Black/African descent may have more severe courses, and further research is required to determine why.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium***

### 191. Adult Loxoscelism: a Review of Brown Recluse Bites in the Toxicology Investigators Consortium (ToxIC)

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**Background:** The brown recluse spider (*Loxosceles reclusa*) is one of few medically relevant spiders in North America. Envenomations can result in local and systemic symptoms. Signs and symptoms of loxoscelism can include local effects such as necrosis and blistering, while systemic effects can include fevers, rash, transaminase elevation, and hemolysis. No antivenin is currently approved in the US, and data to support pharmacologic therapies are limited.
**Methods:** This is a retrospective review of the Toxicology Investigators Consortium (ToxIC) registry from January 2010-September 2022 that included patients 19 years of age or older seen at the bedside by a medical toxicologist and determined to have a brown recluse envenomation. Statistics are descriptive.
**Results:** Twenty-six cases were analyzed with an average age of 40.5 years. Dermatologic manifestations were common, with 14 (54%) patients experiencing a rash, 14 (58%) experiencing necrosis, and five (23%) experiencing blistering. Five (19%) envenomations resulted in hemolysis. Of these patients, one received steroids and one required transfusion. Of the 18 patients with known race data, 3/6 (50%) Black/African patients experienced hemolysis versus 1/12 (8%) patients with any other race documented. Rash was documented for 3/6 (50%) Black/African patients compared to 1/12 (8%) from other races. Other hematologic abnormalities were uncommon with one patient experiencing thrombocytopenia, and two patients with significant leukocytosis.
**Discussion:** Our data indicates that severe loxoscelism in adults is uncommon. The most common manifestations are dermatologic and hemolytic, with patients recovering after supportive care. Interestingly, our limited data supports anecdotal evidence that patients of Black/African descent have more severe responses to loxoscelism than other races, though reasoning is unclear.
**Conclusion:** Rash and hemolysis are common manifestations of loxoscelism. Adult patients rarely have severe envenomations. Patients of Black/African descent may have a more severe course, and further research is required to determine why.

***ToxIC: This research was performed by the ACMT Toxicology Investigators Consortium**

### 192. It's (Not) Going Down: Treating *Crotalus Horridus* Envenomation Without Rebound/Persistent Severe Thrombocytopenia Using Crotalidae Immune $F(ab')_2$ Antivenom

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**Background:** Timber rattlesnake (*Crotalus horridus*) envenomation described in previous literature, which has been traditionally treated with crotalidae polyvalent immune Fab, has been associated with rebound/persistent severe thrombocytopenia refractory to antivenom. There is no known literature describing the newer crotalidae immune $F(ab')_2$ antivenom as the sole antivenom for timber rattlesnake envenomation. Hypothesis: Crotalidae immune $F(ab')_2$ antivenom may be more effective at treating the severe thrombocytopenia associated with timber rattlesnake envenomation.

**Methods:** This is a single patient case report. A healthy 37-year-old male presented to the hospital with a timber rattlesnake envenomation. He was feeding his pet timber rattlesnake when the snake bit the patient's right thumb. On arrival, he had right hand/wrist erythema and edema. He also had right hand and forearm paresthesias and fasciculations. His initial lab work demonstrated a platelet count (PLT) of 12 x $10^9$/L (ref: 150-450 x $10^9$/L) with a normal prothrombin time. He received 10 vials of crotalidae immune F(ab')$_2$ antivenom and was admitted.
**Results:** His swelling, pain, and paresthesias improved after antivenom administration. He did not develop any localized necrosis, hemorrhagic bulla, or episodes of spontaneous bleeding. The swelling and ecchymosis migrated down the right arm and was stable prior to discharge. The PLT initially rose to 109 x $10^9$/L six hours after antivenom administration and fell to 41 x $10^9$/L the following 24 hours. He was discharged home and repeated PLT three days later and improved to 53 x $10^9$/L.
**Conclusion:** Crotalidae immune F(ab')$_2$ antivenom, which was developed from *Bothrops asper* and *Crotalus durissus* venoms, can successfully treat *Crotalus horridus* envenomation without developing severe rebound/persistent thrombocytopenia. We are hopeful this case highlights crotalidae immune F(ab')$_2$ will more effectively treat rebound/persistent severe thrombocytopenia in the timber rattlesnake in our geographic region.

### 193. It's a Bleed! It's a Stroke! Oh Wait, It's Carbon Monoxide Poisoning!

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**Background:** Carbon Monoxide (CO), an odorless and colorless gas, displaces oxygen from hemoglobin, disrupts the electron transport chain, causes vasodilation, and directly damages central nervous system tissue. Hypothesis: CO can cause neurological demand ischemia and mimic a cerebrovascular accident (CVA) in a patient with underlying cerebral vascular disease.
**Methods:** This is a single patient case report. A 77-year-old woman with a history of coronary artery disease, subclavian steal syndrome, and hypothyroidism presented to an outside hospital with left sided hemiparalysis and confusion. Her initial neuroimaging, including a brain MRI, was unremarkable for a CVA. Fourteen hours into her evaluation, it was discovered that she was found down at home with two stove burners on. Initial carboxyhemoglobin level was 38%, and she was transferred to a tertiary care facility (TCF) for further management. At the TCF, she had garbled speech, a right gaze deviation that did not cross midline, and left sided hemiparalysis. Repeat carboxyhemoglobin was 1.8% at the TCF. Patient underwent hyperbaric oxygen (HBO) therapy and repeated neuroimaging. Patient's care required a multidisciplinary approach with toxicology, stroke neurology, and neurosurgery.
**Results:** The patient received three HBO sessions with neurological improvement after each session and had complete resolution 24 hours after the last session. Initial neuroimaging demonstrated high grade (80%) right internal carotid artery stenosis which was consistent with her presentation. Repeat brain MRI did not show any acute cerebral infarction. Hospital course was complicated by acute delirium during transfer from intensive care unit to floor bed. Patient's mental status returned to baseline 96 hours later, and the patient was discharged home on hospital day eight with plan for elective outpatient carotid endarterectomy.
**Conclusion:** CO toxicity can mimic a CVA in patients with underlying cerebral vascular disease. These patients may benefit from HBO therapy to improve neurological function.

### 194. Mexican Beaded Lizard Envenomation

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**Background:** Envenomation from the Mexican beaded lizard (Heloderma horridum) is rare. There is only one published case report of anaphylaxis/anaphylactoid reactions secondary to lizard envenomation. We report a case of Mexican beaded lizard (MLB) envenomation resulting in an anaphylaxis-like reaction.
**Case Report:** A 35-year-old male presented to the emergency department (ED) after being bitten on bilateral hands by a MBL 30 min prior to arrival. The patient developed sudden pain in his hands, nausea, and vomiting. He soon became diaphoretic and developed blurry vision. The patient was the owner of the animal and attended a local exotic reptile show. The patient owns multiple exotic reptiles and stated he had been bitten by "almost all" of his reptiles at least once. The patient does not recall being bitten by his MBL before. On presentation to ED, the patient's vitals were afebrile and within normal limits. He soon developed rapid swelling to the bilateral hands/forearms, shortness of breath, and expiratory wheezing. ECG performed notable for slight inferolateral ST depressions. The patient soon became hypoxic (SpO2 = 85%) and hypertensive (227/103). The patient was administered intravenous pain medication (fentanyl), dexamethasone, diphenhydramine, famotidine,

ondansetron, lorazepam, Boostrix, ampicillin/sulbactam, and one liter lactated ringers. Soon after the administration of medications, symptoms began to improve. Wheezing, upper extremity swelling, and hypertension were resolved two hours after medication administration. After a period of observation, the patient was discharged home on amoxicillin/clavulanic acid. During a phone follow-up with the poison center two days after the event, the patient reported ongoing hand pain at the location of the MBL bites. Otherwise, he was feeling close to his baseline.
**Conclusion:** There are few published case reports of envenomation by the MLB. Exotic animal handlers and medical personnel may be unaware of the risks associated with these bites.

## 195. Poisoning by Unintentional False Hellebore Ingestion

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**Background:** All parts of the False Hellebore (Veratrum viride) plant (FH) contain toxic sodium channel activators called veratrum alkaloids. These toxins can produce nausea, vomiting, bradycardia, and hypotension. FH bears a morphologic resemblance to non-toxic wild ramps/leeks (Allium tricoccum), a member of the onion family.
**Case Report:** A 69-year-old male presented to the emergency department following unintentional ingestion of two to three leaves of FH after attempting to forage for wild ramps. Around two hours after ingestion, the patient developed nausea, vomiting, diarrhea, and bradycardia with a heart rate (HR) of 38 beats/minute. Initial blood pressure (BP) was 162/80. ECG showed ectopic atrial bradycardia, nonspecific intraventricular conduction delay, and abnormal inferior Q waves. The patient received 0.5 mg atropine with an improvement of HR to 80 beats/minute. Two hours later, the patient developed recurrent bradycardia (HR 48 beats/minute) and newly reported hypotension (BP not recorded). The patient was then started on three mg/hr dopamine infusion and admitted to the intensive care unit (ICU). In the ICU, dopamine infusion was continued, and he was treated symptomatically for ongoing nausea and vomiting with pantoprazole and ondansetron. Eleven hours after initial ingestion, the patient's BP had normalized (133/54 mmHg), but he remained bradycardic (HR 44 beats/minute). The patient remained in the ICU on a three mg/hr dopamine infusion for three days with persistent bradycardia and ongoing nausea, vomiting, and diarrhea. His symptoms resolved on hospital day three, with his HR reaching 80 beats/minute, and he was discharged home on hospital day four.
**Conclusion:** Non-toxic wild ramps/leeks may be confused with toxic FH due to similar morphologic characteristics. Caution must be used when foraging, as small ingestions of FH can result in significant toxicity for an inexperienced forager. Toxic ingestions should be on the differential when assessing foragers in the emergency department.

## 196. Prolonged Venom-Induced Consumptive Coagulopathy Following *Protobothrops mangshanensis* Envenomation Despite Hemato Polyvalent Antivenom Administration

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**Background:** The Mangshan pit viper (*Protobothrops mangshanensis*) is a venomous snake endemic to China. We report a case of life-threatening envenomation from a captive Mangshan pit viper that resulted in acute, recurrent, and prolonged venom-induced consumptive coagulopathy (VICC) despite multiple doses of antivenom.
**Methods:** This is a single patient chart review. A 46-year-old male zookeeper presented to a tertiary care hospital after sustaining a single *P. mangshanensis* bite to the abdomen and was treated with Hemato Polyvalent Antivenom (HPA) that was brought to the hospital with the patient.
**Results:** Within one hour of envenomation, he developed oozing of sanguineous fluid and ecchymosis at the puncture site. After receiving two vials of HPA, he developed hypotension and was treated with epinephrine, corticosteroids, and antihistamines for a presumed hypersensitivity reaction. Antivenom was held until he clinically stabilized. The coagulation profile fluctuated throughout his course, with the following peak/nadir values and corresponding hospital day (HD): undetectable fibrinogen HD 0 and 2, d-dimer 7.43 mg/L and INR 1.46 HD 2, and platelets 98 109/L HD 5. He received 30 vials of HPA in total over five days and one unit of cryoprecipitate on HD 7. Upon discharge on HD 8, laboratory studies were normalizing. At his two-week follow-up, the patient reported being functionally back to baseline.
**Conclusion:** Zookeepers are at risk of envenomation due to contact with exotic species. This case report summarizes *P. mangshanensis* envenomation of the abdomen with prolonged VICC despite antivenom administration that was complicated by hypotension.

## 197. A Recipe for Hepatic Failure & Death: a Cluster of Co-workers Made a Wild Mushroom Soup

Catherine Dong[1,2], Andrew Chambers[1,2], Holly Farkosh[1], Jared Berger[1], Alex Robinson[1], Alan Turner[1], Heloisa DeCarvalho[1], Emily K Kershner[1,2], Brandon K Wills[1,2], Michelle M Troendle[1,2]
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**Background:** Cyclopeptides are taken up into hepatocytes using the organic anion transporter (OAT) and inhibit RNA polymerase II, leading to cell death. Small amounts including a single mushroom have been reported to be fatal. Numerous treatment options have been explored including prevention of protein binding, prevention of transport into hepatocytes, and disruption of enterohepatic circulation. However, there is little consensus on the best treatment for these ingestions.
**Methods:** This is a case series of four men of ages 27, 37, 38, and 51 for patients 1 through 4, respectively. We describe the treatments and the clinical course of four patients who consumed varying amounts of a hepatotoxic mushroom soup, presumed to be containing cyclopeptides. They presented to a small emergency department with complaints of GI upset approximately 9 hours after sharing a mushroom soup, made from a cluster of mushrooms they picked near their workplace. On hospital day (HD) 0, labs began to demonstrate elevated transaminases, and they were transferred to a tertiary care center. N-acetylcysteine IV, multi-dose activated charcoal, and high-dose Penicillin G IV were initiated. On HD 2, IV silibinin hemisuccinate was approved for emergency use.
**Results:** All four patients suffered significant hepatotoxicity, with severe coagulopathy and delayed encephalopathy. Transaminases peaked around HD 3. Patients 2 and 3 were discharged by HD 6 and 8, respectively. Patient 4 developed acute liver failure, becoming hypotensive, oliguric, and encephalopathic on HD 4, requiring vasopressor support, CRRT, and intubation. On HD 12, he had an episode of massive hematemesis and died. Patient 1 received plasmapheresis on HD 2, started on CRRT on HD 3, developed encephalopathy and was intubated on HD 7, and died on HD 14.
**Conclusion:** Despite aggressive supportive care and treatments including IV silibinin, two of four patients died.

## 198. An Unlucky Mushroom Foraging: Accidental Amanita phalloides Ingestion with Delayed Presentation in the DC Metro Area

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**Background:** *Amanita phalloides* is responsible for the majority of deaths related to mushroom ingestions. The toxicity is due to the amatoxins resulting in both fulminant hepatic and renal failure.
**Hypothesis:** Mushrooms not native to an area can be introduced, resulting in toxicity when inadvertently consumed.
**Methods:** This is a single patient case review. A 69-year-old man who regularly foraged for wild mushrooms presented to a hospital in the Washington DC metropolitan area with nausea and diarrhea 4 days after ingesting what he thought were button cap mushrooms. He was found to be in liver and renal failure with an aspartate aminotransferase (AST)/alanine aminotransferase (ALT) of 1679/3269 u/L, creatinine 9.3 mg/dL, and INR 1.8. He brought in the mushrooms and based on mycologist identification and clinical presentation, *Amanita phalloides* toxicity was suspected. Poison control was contacted, and the patient was transferred to a liver transplant facility. He was started on high dose penicillin, n-acetylcysteine, and silibinin infusion. The mushroom was sent for confirmatory testing because it is not native to the area.
**Results:** On arrival at the transplant center, the patient was hemodynamically stable but continued to have diarrhea. Silibinin infusion was continued for 96 hours in conjunction with n-acetylycysteine and penicillin. AST/ALT peaked at 3644/7115 u/L on hospital day two. He was stepped down from the ICU on hospital day three. While his hepatic enzymes eventually normalized, his renal function worsened despite initial improvement and dialysis was initiated on hospital day 11. His renal function and he was discharged on hospital day 18. Genetic testing of the mushroom confirmed it was *Amanita phalloides*.
**Conclusion:** *Amanita phalloides* ingestion requires prompt and aggressive treatment. Providers must consider the possibility of non-native mushroom ingestion and initiate treatment based on clinical presentation while awaiting confirmatory testing.

## 199. Trends in U.S. Poison Center Data Involving Hallucinogenic Mushrooms

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[1]*University of Virginia, Charlottesville, VA, USA.* [2]*Eastern Virginia Medical School, Norfolk, VA, USA*

**Background:** Surveys report that use of hallucinogenic mushrooms is increasing, especially in younger age groups. This may be in part due to the misperception that natural substances have a low risk of adverse outcomes.
**Research Question:** Examine the epidemiological trends of hallucinogenic mushroom exposures reported to United States (U.S.) poison centers (PCs) and associated case outcomes.
**Methods:** The National Poison Data System (NPDS) was queried for hallucinogenic mushroom exposures reported to PCs from 2011 to 2021. Cases were identified and descriptively assessed for relevant demographic and clinical characteristics. Poisson regression models were used to evaluate trends in the number and rates (per 100,000) of hallucinogenic mushroom exposures.
**Results:** There were 6,618 hallucinogenic mushroom exposures reported during the study period. Among these, 64.6% of cases reported were from acute care hospitals. 68.2% were single substance exposures. Teenage exposures (37.2%) were the most common age group. Males accounted for 73.2% of cases. Most exposures occurred in a residence. Ingestion was the most common route of exposure. The most frequently co-occurring substances were alcohol (8.8%) and marijuana (10.2%). Intentional misuse (75%) was the most common reason for exposure. 51% of cases were treated and released from an emergency department and 8.4% were admitted to a critical care unit. Moderate effects were reported in 44.5% of cases and major effects reported in 4% of the cases. Agitation and hallucinations were the most common clinical effects. Intravenous fluids (32.7%) and benzodiazepines (24.9%) were the most frequently administered therapies. During the study period the frequency and rate of hallucinogenic mushroom exposures increased by 83% and 106%, respectively.
**Conclusions:** The number of hallucinogenic mushroom exposures called to U.S. PCs increased significantly over the study period. These natural products can be a significant health risk, especially among youth, and a significant number require hospitalization.

## 200. Antimuscarinic Toxidrome Caused by Lupin Bean Ingestion

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**Background:** The Consumption of Lupin beans is common in some parts of the world as a snack or a coffee substitute when roasted. These legume seeds belong to several species within the genus Lupinus L. that contain bitter quinolizidine alkaloids, such as lupanine, lupinine and sparteine that contribute to the toxicity of these seeds. These alkaloids cause blockade of muscarinic and nicotinic acetylcholine receptors, resulting in anticholinergic toxicity. Debittering of the seeds is necessary before consumption to detoxify the alkaloids. This is usually achieved by boiling the seeds and soaking them in water for several days, with frequent water changes. Antimuscarinic toxicity following Lupin bean consumption is rare, with only few cases reported in the literature.
**Methods:** This is a single patient chart review. A 49-year-old woman with no past medical history and not on any medications presented to the emergency department (ED) after ingesting a cup of poorly prepared Lupini beans. Shortly after ingestion, she felt dizzy and had a dry mouth and slurred speech. Her physical exam was remarkable for dilated and non-reactive pupils and confusion. She was monitored and received IV fluids. Her symptoms improved within 6 hours with no intervention and she was at her baseline upon discharge.
**Conclusion:** Consumption of poorly prepared Lupini beans can result in antimuscarinic toxicity. Toxicologists and ED physicians should be aware of this as a potential cause of antimuscarinic toxicity. Toxicity is usually mild and requires only supportive treatment similar to other antimuscarinic toxicities, however physostigmine can be considered in patients with moderate to severe toxicity.

## 201. A Case of Mycotoxin Poisoning via Ingestion of Kodo Grain

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**Background:** Mycotoxin poisoning outbreaks associated with grain ingestions are rarely reported in modern Western literature, but several exist in South Asian journals, particularly associated with kodo millet seeds, reported under different dialects: koda, varagu, and others. Kodo, or Paspalum scrobiculatum, is produced in multiple countries and is a major Indian food source. Ingesting secondary mycotoxin compounds, such as aflatoxin and cyclopiazonic acid, is associated with this poisoning.
**Research Question:** Kodo poisoning may be less known in the US for a variety of factors; climate change and global trade may increase cases.
**Methods:** This is a report of a case called into Illinois poison center, that was then referred to medical toxicology for a telemedicine consult.
**Results:** A 76-year-old male, with no past medical history, presented to the emergency department for acute altered mental status and gastrointestinal upset. His wife noted the consumption of uncooked, imported millet seeds 11 hours prior which were purchased from a specialty Indian grocer as a new diet item. Approximately 2.5 hours later, the patient developed confusion, dizziness, lethargy, nausea, vomiting, and hand tremors; and his wife reported similar symptoms. His wife attributed this to possible Kodo poisoning, triggering a call to our poison center. Vitals were stable and an EKG was normal; all other imaging and labs were unremarkable. Treatment included fluid resuscitation, antiemetics, and aspirin. Because of persistent altered mental status, the patient was admitted to the step-down unit for additional neurological work-up, which was unremarkable. The patient was clinically improved the next day, required no additional treatment, and was discharged in stable condition.
**Conclusion:** History and physical are crucial, symptomatic management is recommended. Mycotoxin-contaminated grains have toxicology practice and public health implications.

## 202. Plant Identification Applications Do Not Reliably Distinguish Potentially Toxic from Edible Plants in the Midwest

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**Background:** Toxic ingestions as a result of incorrect identification of plants are a global problem, and occasionally result in death. Thousands of calls to poison control centers occur annually in the United States due to toxic plant exposures. Individuals with limited botanical knowledge may be tempted to rely on smartphone applications to determine if plants are safe to forage. This diagnostic utility study evaluated the reliability of four popular smartphone applications to identify foraged plants and distinguish them from potentially toxic plants in the Midwestern United States.
**Methods:** Sixteen plant species were selected based on local availability, attractiveness as foraged food, and potential for misidentification. Plant specimens were identified by doctorate level botanists and photographed during multiple stages of their growth cycles. LeafSnap®, PictureThis®, Pl@ntNet® and PlantSnap®, were used to identify the specimens.
**Results:** Overall accuracy of the applications in identifying plant genus was 76.1% (range 96.1 PictureThis® to 53.1% for Pl@ntSnap®). Five of eleven potentially toxic species were identified as an edible species by at least one application.
**Conclusion:** Accuracy of the smartphone applications varies, and currently, they cannot reliably identify edible plants. Traditional plant identification methods should be employed to properly and safely identify foraged plants. At this time, foragers must have adequate botanical knowledge to ensure safe harvesting and consumption of wild plants.

## 203. Chemical Skin Injuries Caused by Topical Application of Garlic: Report of Three Cases

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**Background:** Garlic (*Allium sativum*) is widely used in alternative medicine due to its antimicrobial, carminative, anticoagulant, immunostimulant, and anti-inflammatory properties. Sulfoxides are compounds of *A. sativum* that contain a sulphonyl group bound to two carbon atoms, which on contact with the skin, have irritating effects, modifying the juncture of the epidermis and developing coagulation necrosis.
**Case Reports:** Case one: A 25-year-old female reported an unspecified spider bite, had itching on the right ankle, so she applied crushed garlic on the area for an hour. 24 hours later, burning pain and an ampule surrounded by erythema was added. Case two: A 14-year-old female suffered a wasp sting in the forearm. Her mother applied aloe balm and garlic poultice to the sting area, after which she presented edema of the forearm and developed two ampules with serous content

on the application area. Case three: A 36-year-old female who reported an unspecified sting on her right foot. Crushed garlic was applied on the zone and after 24 hours a serum-containing ampule was added, which progressed to hemorrhagic bullae and necrosis.
**Discussion:** The popular belief that natural products are safe promotes the use of this and other potentially harmful remedies. Additionally, the patient can hide said practices from his doctor because he does not consider it relevant or to avoid being judged. However, it is important to consider garlic injuries as a differential diagnosis from other chemical burns, infections or skin envenomation in order to establish an opportune treatment.
**Conclusion:** Health professionals should consider sulfoxide burns as a differential diagnosis when lesions due to insect or arthropod bites or stings have a distorted evolution and patients should be counseled on the potential deleterious effects of home remedies containing garlic.

### 204. Crataegus Mexicana (Tejocote) Exposure in a 23 Month-Old With Cardiac Toxicity

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**Background:** *Crataegus mexicana* (Tejocote) supplements have been reported to cause cardiotoxicity similar to digoxin with some cross-reactivity on digoxin immunoassays. However, the utility of digoxin immune fab in managing these patients is unclear. We report on a case of ECG normalization after the administration of digoxin immune fab in a suspected exposure to Tejocote.
**Methods:** A 23-month-old female was found chewing on a piece of a supplement purported to contain Tejocote extract. One hour later the patient developed nausea and vomiting, prompting a presentation to an Emergency Department. On evaluation the patient was bradycardic for her age at a rate of 93 beats per minute and poison control was consulted. ECG revealed sinus bradycardia with a rate of 66 beats per minute and frequent PVCs. The serum potassium level was 4.4mEq/L and the serum Digoxin concentration was 0.5ng/L. A single vial of digoxin immune fab was administered and serial ECGs were performed.
**Results:** The patient's ECG 5 hours post-administration showed normal sinus rhythm. 12 hours post-administration, a repeat ECG showed what was believed to be a second degree AV block, bradycardia, and frequent PVCs. A second vial of digoxin immune fab was administered with normalization of the ECG. 10 hours after administration of the second vial, the patient again developed PVCs, without AV block or bradycardia. No additional vials of digoxin immune fab were administered. The patient was discharged on hospital day three with a normal ECG.
**Conclusion:** Patients presenting with a suspected exposure to Tejocote or other Crataegus species with evidence of cardiac toxicity should receive empiric digoxin immune fab. Further study is needed to understand the causative xenobiotic and digoxin immune fab's effectiveness as antidotal therapy.

### 205. A Fatal Ackee (*Blighia sapida*) Fruit Toxicity: Case Report from a Sri Lankan Rural Family

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**Background:** Ackee fruit (*Blighia sapida*) toxicity resulting in hypoglycemia, gastrointestinal symptoms, central nervous system depression, and subsequent fatalities due to its constituent toxins, 'hypoglycin A and B', has been reported sporadically in global literature. The unripe fruit (aril, seeds and inedible parts) contain the toxin in high concentration. The ripe fruit which split open, contain much less toxin and is cooked and consumed in some countries.
**Hypothesis:** Consumption of unripe fruit leads to the fatal syndrome described above.
**Method:** This is a case report of a 68-year-old male and his 63-year-old wife who became severely ill following consumption of a curry made of unripe aril of ackee fruit (*B. sapida*). They have been found unresponsive for over 24 hours. The wife had episodes of vomiting but recovered with treatment. The man had vomiting, haematemesis, hypoglycaemia, seizures, and loss of consciousness. Despite supportive care including dextrose infusions, and subsequent intensive care, he succumbed to his illness 72 hours after the culprit meal. His medical history included chronic obstructive lung disease, hypertension, and stroke. They remained under control. A dietary recall survey did not reveal consumption of other toxic substances.
**Results:** The source of the fruit had been an ornamentally grown plant under the incorrect identity of 'Malaysian cashew'. Following the fatality, plant experts identified it as *B.sapida*. Enquiry noted that the unripe aril of the fruit had been consumed. The man developed a classically described clinical illness resembling Reye syndrome. Postmortem examination including toxicology did not reveal any alternative cause for the death.

**Conclusion:** This is the first reported fatal case of *B.sapida* poisoning in Sri Lanka. Public awareness about the toxicity of *B.sapida*, and correct harvesting of the ripe fruit is a timely need to prevent similar fatalities, as the plant must have reached wider geographical areas of the country.

### 206. 'Essentia-lly Alkalemic': Severe Metabolic Alkalosis and Life-Threatening Hypokalemia After Chronic Alkali Water Consumption: a Case Report

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**Background:** Commercially available alkaline water, including "Essentia" (pH 9.5), has increased in popularity. The suggested health benefits of alkaline water include antioxidant, immune support, and homeostatic effects. However, there is a dearth of literature as to the adverse effects of alkaline water consumption. We report a case of metabolic alkalosis and profound hypokalemia in the setting of daily Essentia water consumption.
**Case Report:** A 48-year-old female with a past medical history of gestational diabetes, mitral valve prolapse, necrotizing pancreatitis, and portal venous thrombosis, presented to the emergency department (ED) after three weeks of lethargy, weakness, difficulty walking, and vomiting. She endorsed having only two episodes of emesis during the illness, as well as progressive difficulty walking with five associated falls. She endorsed daily consumption of Essentia Mineral Water (pH 9.5) for the month prior to presentation (five liters per day). Vital signs were: heart rate 121 beats/minutes; blood pressure 129/106 mmHg; respiratory rate 16 breaths/minute; oxygen 100% on room air; temperature 101°F. Electrocardiogram showed sinus tachycardia with a QTc of 630 milliseconds. Initial labs showed: pH 7.69; bicarbonate 54 mEq/L; PCO2 43; potassium 1.6; lactate 13.2; magnesium 0.9 mEq/L. In the ED she received two grams of magnesium, two liters of normal saline, and 70 milliequivalent (mEq) of potassium chloride (KCl), without significant improvement of the lab derangements. She was admitted to the intensive care unit (ICU) for further electrolyte/fluid repletion and QTc monitoring. While in the ICU, she received an additional 40 mEq of KCl. However, her potassium eventually rebounded to 6.6, which was reflexively treated with calcium, insulin, and dextrose. Ultimately, after four days of supportive care, the patient returned to normal electrolyte levels.
**Conclusion:** There is limited data on metabolic alkalosis and hypokalemia after alkaline water ingestion. This case demonstrates the potential for severe alkalemia and symptomatic hypokalemia after a chronic alkali water ingestion.

### 207. A Fruitful Source of Cyanide: a Case Report of Suicide Attempt by Amygdalin Ingestion

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**Background:** Amygdalin is a naturally occurring cyanogenic glycoside found in bitter almonds and the pits of stone fruits like apricot and plum. Often marketed as a dietary supplement, amygdalin is available for purchase online creating potential for fatal ingestions.
**Methods:** This is a single patient case report. A 35-year-old woman ingested 50 capsules of apricot pit extract/amygdalin in a suicide attempt. The patient called 911 to report the ingestion and stated that she pre-medicated her ingestion with ondansetron eight mg. She was brought to the ED by EMS three hours after ingestion requiring BVM ventilation and was intubated. Her initial vitals signs were pulse 98 bpm, blood pressure 142/102 mmHg, temperature 38.6 °C, respiratory rate 12, and SpO2 97%. Laboratory analysis demonstrated an elevated anion gap metabolic acidosis of 21, CO2 13 mmol/L, and elevated lactate 11.6 mmol/L. Arterial blood gas demonstrated a pH 7.11, pCO2 40 mmHg, pO2 72 mmHg and HCO3 15 mmol/L. The patient was treated empirically for cyanide toxicity with 12.5 g intravenous sodium thiosulfate and five grams intravenous hydroxocobalamin and admitted to the intensive care unit (ICU).
**Results:** Repeat lactate and blood gas analysis were performed with lactate 3.0 mmol/L at hour four and 1.2 mmol/L at hour eight with resolution of acidosis. The patient was extubated on hospital day three and admitted for psychiatric care.
**Conclusion:** During follow-up, the patient disclosed that she works as a medical lab technician and researched the toxic metabolites of amygdalin herself. She purchased a bottle of apricot extract capsules containing amygdalin on the internet and blended the capsules into a smoothie and pre-medicated ingestion with ondansetron to prevent vomiting. This case demonstrates the need for heightened suspicion of deadly overdose in professionals and underscores the danger of non-FDA regulated dietary supplements available for online purchase.

### 208. Cardiogenic Shock and Elevated Digoxin Level Associated with Ingestion of Tejocote (*Crataegus mexicana*) Root

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**Background**: Tejocote (*Crataegus mexicana*) is a species of hawthorn often marketed as a weight-loss supplement. It contains cardioactive glycosides and can result in cardiotoxicity. We report the case of a patient who developed cardiogenic shock after ingesting tejocote, with a measurable digoxin level.

**Methods**: This is a single patient chart review. A 46-year-old female presented to the emergency department with a one-day history of somnolence, chest pain, generalized weakness, and vomiting. Family members reported her having ingested a weight loss supplement containing tejocote root daily over the previous several days.

**Results**: The patient's vital signs were remarkable for a pulse rate of 40 bpm and blood pressure of 76/40 mmHg. She initially required rescue breathing due to somnolence and shallow breathing. Fluid resuscitation was initiated, and she was started on a dopamine infusion, resulting in improvement in her heart rate and blood pressure. EKG demonstrated atrial fibrillation with slow ventricular response (40 beats/minute). Laboratory testing was remarkable for an initial troponin of 0.043 ng/mL (which peaked at 0.099 ng/mL) and a digoxin level of 0.5 ng/mL. Potassium was normal at 4.0 mmol/L. Urine drug immunoassay was negative for opioids, fentanyl, and benzodiazepines. Digoxin-specific antibody (Fab) fragments were not administered, given improvement with standard resuscitative measures. Cardiology was consulted and an echocardiogram was performed the following morning, showing a left ventricular ejection fraction of 60%. The patient's hemodynamic status eventually stabilized off pressor agents and she was discharged on hospital day three.

**Conclusion**: Tejocote (*Crataegus mexicana*) ingestion can cause clinically significant cardiotoxicity similar to that of other cardiac glycosides and can cross-react with commercial digoxin assays, resulting in a falsely elevated digoxin level. Physicians should be aware of the toxic potential of this product, which is readily available and marketed as a dietary supplement.

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