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ANNUAL MEETING ABSTRACTS

ACMT 2018 Annual Scientific Meeting Abstracts—Washington, DC

Abstract: These are the abstracts of the 2018 American College of Medical Toxicology (ACMT) Annual Scientific Meeting. Included here are 174 abstracts that will be presented in April 2018, including research studies from around the globe and the ToxIC collaboration, clinically significant case reports describing new toxicologic phenomena, and encore research presentations from other scientific meetings.

Keywords: Abstracts - Annual Scientific Meeting - Toxicology Investigators Consortium - Medical Toxicology Foundation - Pediatric Environmental Health Specialty Units

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Introduction: The American College of Medical Toxicology (ACMT) received 225 eligible research abstracts for consideration for presentation at the 2018 Annual Scientific Meeting (ASM), including 119 research studies and 106 case reports. Each abstract was reviewed in a blinded fashion by at least four Research Committee members. Each abstract was independently scored based on the clinical question, data source, analytic method, results/conclusion, and clarity of presentation. The overall acceptance rate was 78%, 91% for research studies and 63% for case reports. This work would not be possible without the hard work and diligence of our abstract reviewers: Annie Arens, Vik Bebarta, Katie Boyle, Diane Calello, Stephanie Carreiro, Jon Cole, Kirk Cumpston, Kristin Engebretsen, Yaron Finkelstein, David Jang, Louise Kao, Ken Katz, Kate Katzung, Russ Kerns, JoAn Laes, Eric Lavonas, Michael Levine, Gerry Maloney, Andrew Monte, Mark Mycyk, Travis Olives, Anne Riederer, Sam Stellpflug, Shawn Varney, Richard Wang, Brandon Wills, and Luke Yip. Even more important is the contribution of the ACMT staff: Lizzy Nguyen led the process with significant assistance from Paul Wax. Congratulations to all the contributors whose work will be presented in Washington, D.C.
We look forward to seeing you there.
Sam Stellpflug, MD, FACMT, Abstract Review Chair; Shawn Varney, MD, FACMT, Abstract Review Co-Chair; Russ Kerns, MD, FACMT, Chair, ACMT Research Committee

Day 1: Platforms, Abstracts 001-004

001. Narcan't: Sociodemographic Factors in Retail Pharmacy Naloxone Availability

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Background: Retail pharmacies in NJ are permitted to dispense naloxone without a prescription. However, not all pharmacies have participated in this effort, and it is not clear what factors may impact its availability.

Research Question: How does that availability of naloxone in retail pharmacies compare to the prevalence of opioid-related hospital visits (ORHV), socioeconomic status, and population?
Methods: All retail pharmacies in 10 New Jersey cities were surveyed by phone. The standardized survey instrument asked identical questions to each pharmacist concerning the stocking of naloxone for dispensing. A single investigator conducted all the surveys. Population data and socioeconomic data for each city were obtained from census.gov. ORHV was obtained through the NJ SHAD database. Using these data, the prevalence of ORHV was calculated. Naloxone availability was plotted against the prevalence of ORHV, socioeconomic status, and population. Pearson's coefficients were calculated to assess correlation.
Results: Ninety pharmacies in total were surveyed. Naloxone availability ranged from 15.4 to 67.7% by city. Naloxone availability was lowest in the cities where the prevalence of ORHV was the highest (*R:* − 0.46) and those with the largest population (R: − 0.51). Availability was highest in cities with the highest median household income (*R:* 0.69).
Discussion: This study suggests a complex yet concerning pattern: patients living in the most populous poorer areas, where opioid overdoses are the most common, are also living in areas where fewer pharmacies have naloxone available. Our findings may reflect a need for targeted improvement in naloxone availability, especially the poorest areas where opioid-related hospital visits are the most prevalent. Further study should seek to develop and evaluate strategies to enhance the consistency of naloxone stocking.
Conclusion: Naloxone availability in retail pharmacies is inversely related to the prevalence of opioid-related hospital visits and population, and directly related to median household income.

002. Comparison of Buprenorphine and Methadone Exposures Reported to the U.S. Poison Centers 2013–2016.

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Background: Buprenorphine and methadone are widely used in the US society. We investigated and compared the trends and characteristics of buprenorphine and methadone exposures reported to the US Poison Centers (PCs).
Methods: We retrospectively identified all closed, human exposures to buprenorphine and methadone as reported to the National Poison Data System (NPDS) from 2013 to 2016, as specified by the generic codes 0200625 and 0037703, respectively. Trends in buprenorphine and methadone exposures were evaluated by using Poisson regression. We descriptively assessed key demographic and clinical characteristics of the exposures using chi-squared tests.

Results: Buprenorphine exposure calls increased by 12.3% ($p = 0.01$) from 2013 (3321) to 2016 (3731). In contrast, methadone exposure calls decreased by 23.1% ($p < 0.001$) from 2013 (3777) to 2016 (2906). Adults between 20 and 39 years (40.2 and 40.1%), and males (53.2 and 52.4%, $p = 0.16$) constituted the highest percentage of buprenorphine and methadone cases. The proportion of suspected suicides (15.7 vs 29.7%, $p < 0.001$) and drug abuse (20.6 vs 22.1%, $p < 0.001$) was higher in methadone exposures. Compared to buprenorphine exposures, major clinical effects (4.7 vs 13.7%, $p < 0.001$) and deaths (0.3 vs 1.27%, $p < 0.001$) were more frequent with methadone. Methadone exhibited a significantly higher number of deaths due to intentional exposures (85 vs 53.5%, $p < 0.001$). Single-substance exposures were more commonly reported for buprenorphine exposures (60.4 vs 41.1%, $p < 0.001$). Buprenorphine exposure cases were less frequently admitted to the critical care unit as compared to methadone exposures (26.1 vs 34.1%, $p < 0.001$). Multiple substance exposures accounted for a higher proportion of major medical outcomes in buprenorphine exposures (73.1 vs 32.9%). The most common product reported for buprenorphine exposures was the Suboxone film (37.8%).
Conclusions: Buprenorphine exposures were more frequently reported compared to methadone exposures during the study period. Buprenorphine demonstrated fewer mortalities and major outcomes compared to methadone. Buprenorphine exposure cases were less frequently admitted to the critical care unit as compared to methadone exposures. These outcomes might be attributed to the "ceiling effect" property of buprenorphine.

003. Quantification of Fentanyl Exposure to Health Care Workers: Environmental Sampling in Overdose Prevention and Supervised Consumption Service Sites

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Background: In response to the overdose crisis, the Province of British Columbia (BC) established Overdose Prevention Services (OPS) and increased Supervised Consumption Services (SCS). These facilities enable drug users to access health services, consume drugs under observation, and be resuscitated if necessary. Health Care Workers (HCWs) at such sites have expressed concerns regarding exposure to fentanyl and opioid analogues. Little published literature exists on occupational exposure risks to HCWs dealing with opioid overdoses. The objective of this project is to assess inhalation and surface fentanyl exposure to HCWs in OPS and SCS in BC.
Methods: Five OPS and SCS sites were selected for sampling where identified at-risk HCWs were sampled for at least one full-shift. Standardized controls were used to calibrate analyses. HCWs wore personal air samplers to collect ambient breathing zone air samples while area air sampling and dust monitoring were taken at the worker's and user's tables. Surface sampling from users' tables was performed at the beginning of shift prior to first use, post-cleaning after first use, mid-shift, and end-of-shift. Fentanyl assays were performed at accredited commercial and governments labs.
Results: The study adopted a 0.1 $\mu g/m^3$ limit used by the pharmaceutical industry for inhalation exposure, and 1 $\mu g/100\ cm^2$ limit for surfaces. No sites had biologically significant levels of fentanyl in the air or on surfaces. Although surface contamination of fentanyl on users' tables was generally below the 1 $\mu g/100\ cm^2$ threshold, levels varied widely and exceeded the threshold on a few occasions. In such cases, the levels were still below those considered biologically active.
Conclusions: Inhalation exposure to fentanyl was minimal. However, the highest fentanyl air level occurred when clients attempted to smoke drugs inside. Contamination from crushing, mixing, and melting drugs was mostly localized. Surface contamination of fentanyl on users' tables was low but varied widely and exceeded the threshold one occasion. In this case, the levels were still below those considered biologically active. Long-term accumulation of fentanyl or other hazardous materials on surfaces cannot be ruled-out so cleaning after every consumption event and the use of disposable impermeable gloves should be mandatory.

004. Novel Illicit Opioids Masquerading as Counterfeit Pharmaceuticals on the Drug Market

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Background: Medical toxicologists are tasked with treating drug overdoses in emergency room settings. Diagnosis and management of drug overdoses are problematic without the challenge of counterfeit pharmaceuticals. Medical toxicologists need to be aware that novel illicit opioids are masquerading as counterfeit pharmaceuticals, which complicates treatment of suspected overdoses.
Methods: This is a retrospective study of drug chemical testing and toxicological data from a large reference laboratory. Data from 2016 to 2017 were reviewed for the confirmation of novel illicit opioids such as furanylfentanyl or U-47700 in submitted counterfeit pharmaceuticals and biological specimens obtained during the course of death investigation, impaired human performance, and suspected overdoses.
Results: In 2016, there was one case of counterfeit oxycodone tablets confirmed as furanylfentanyl, four cases of counterfeit alprazolam tablets confirmed as U-47700, and one case of counterfeit oxycodone tablets confirmed as a combination of U-47700 and furanylfentanyl. In 2017, 10 cases of submitted counterfeit pharmaceuticals actually contained U-47700; one exhibit confirmed the presence of furanylfentanyl and para-fluoroisobutyrylfentanyl in addition to U-47700. Counterfeit alprazolam tablets were chemically confirmed to be a combination of alprazolam and U-47700. Furanylfentanyl and U-47700, after acetylfentanyl, were two of the first novel illicit opioids to emerge, as well as two of the most popular novel opioids in 2016 and 2017, evident by toxicological data from biological specimens. Furanylfentanyl has been confirmed in 1228 blood specimens between October 2016 and September 2017 with a mean and standard deviation of 7.7 ± 31.7 and range 0.1–710 ng/mL. U-47700 has been confirmed in 543 samples (mean 143 ± 388, range 0.2–3800 ng/mL) and *para*-fluoroisobutyryl fentanyl has been confirmed in 563 samples (mean 16.9 ± 46.1, range 0.1–760 ng/mL). Combinations have been reported as well.
Discussion: Novel illicit opioids have been confirmed both in counterfeit pharmaceutical casework and toxicological samples.
Conclusions: Novel illicit opioids masquerading as counterfeit pharmaceuticals are a significant public health threat that medical toxicologists need to be aware of; the presence of these compounds may change treatment due to variable pharmacokinetic parameters such as potency, receptor activation, and binding affinity.

Day 1: Moderated Posters, Abstracts 005-010

005. Call Rates Involving Naloxone to a Single Poison Center

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Background: Opioid-related overdose death has increased dramatically over the past three decades. Naloxone, an opioid antagonist, has become increasingly available through take-home naloxone programs, but it is

unclear if this has translated into increased calls to the poison center involving naloxone.
Research Question: To examine rates of poison center calls involving naloxone and whether naloxone was administered before or after poison center contact.
Methods: This is a retrospective review of all records involving naloxone at a single poison center between 2012 and 2016. Reports were grouped by year and then stratified by whether naloxone was given prior to or after contacting the poison center. Logistic regression was used to evaluate temporal trends in the rates of calls involving naloxone by year.
Results: Of 318,195 poison center calls between 2012 and 2016, there were 8582 cases involving opioids and 1539 cases where naloxone was administered. The rate of poison center calls involving naloxone increased over the study period (+ 0.045% per year on average, $p < 0.001$), with a change from 0.41% (269/65,419) in 2012 to 0.59% (368/62,354) in 2016. The rate of calls where naloxone was given prior to poison center contact also increased over the study period (+ 0.043% per year on average, $p < 0.001$), with a change from 0.35% (231/65,419) in 2012 to 0.52% (322/62,354) in 2016. The percentage of naloxone calls where naloxone was given prior to poison center contact varied between 84 and 88% across each year of the study, though there was no significant change over time (NS).
Discussion: Calls to a single poison center involving naloxone increased between 2012 and 2016, but the data suggest an underreporting of opioid-related toxicities to the poison center. Significant limitations exist, including incorrect reporting and incorrect coding. Furthermore, current coding methods do not specify naloxone indication (diagnostic, opioid, or clonidine reversal), where naloxone was given (pre-hospital, hospital) or by whom (bystander, paramedic, hospital provider).
Conclusion: The poison center can be a resource to monitor naloxone utilization trends, but improvements in poison center data collection and coding will be paramount to improving naloxone programs and surveillance.

006. National Trends and Characteristics of Severe Pediatric Opioid Exposures Reported to US Poison Centers, 2013–2016.

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Background: The increased use of prescription opioids has become a public health emergency. In the present study, we investigated the trends and characteristics of prescription opioid exposures resulting in severe outcomes within the pediatric population utilizing data from the US Poison Centers (PCs).
Methods: We retrospectively identified pediatric exposures (0 and 5 years) to opioids as reported to the National Poison Data System (NPDS) from 2013 to 2016, as specified by the AAPCC generic codes. Confirmed non-exposures during follow-up were excluded. We descriptively assessed key demographic and clinical characteristics of the exposures. Trends in the rates of severe pediatric opioid exposures (per 1000 pediatric exposures) were evaluated using Poisson regression.
Results: There were 363 severe pediatric prescription opioid exposures reported to the PCs demonstrating an increase of 35.9% from 2013 (78) to 2016 (106), despite the overall drop in PC call volume. Most pediatric exposures were unintentional (76.8%). Males accounted for 50.4% of cases. Single-substance exposures accounted for 55.6% of the severe opioid calls with benzodiazepines being the most prevalent co-occurring substance in multi-substance exposures. Exposure at the patient's own residence (88.4%) was most frequent. In 325 cases (89.5%), the patient was en route to the hospital when the PC was called. The most common treatment site was a hospital-based ED (79.6%) with a significant proportion of cases (74.1%) being admitted to the critical care unit. There were 29 deaths reported during the study period. The most frequent opioids resulting in severe pediatric cases, buprenorphine (18 to 25 cases) and methadone (22 to 34 cases), demonstrated significant increases during the study period. Respiratory arrest (24.5%) and coma (26.2%) were common clinical effects seen in the sample. Naloxone (71.4%) and intubation (28.1%) were widely reported therapies. The rate of severe pediatric opioid exposures increased significantly by 26.3% ($p < 0.001$) from 2013 (95.8) to 2016 (121).
Conclusions: This study reflected an increasing trend of severe pediatric opioid exposures, raising the question of accessibility and packaging safety of these medications. Buprenorphine was a common drug exposure in this population highlighting the opioid naivety in children that might limit its ceiling effect.

007. A Recipe for Disaster? Quantification of Opiates in Homemade Poppy Seed Tea

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Background: Poppy seeds are the seeds of *papaverum somniferum* and contain opiates including morphine and codeine. Poppy seeds are available in bulk at low prices. Internet drug forums describe recipes for producing "poppy tea," descriptions of toxicity, and uses including detox from opioid addiction, pain control, and abuse. We sought to determine the quantity of morphine and codeine that can be washed from poppy seeds using online recipes. Internet recipes use various extraction methods including grinding seeds, using whole seeds, adding lemon juice, and using hot or cold water. Various internet anecdotes claim more potent tea is made with whole seeds shaken in cold water with lemon juice.
Methods: Erowid, bluelight, and reddit searches used the phrase "poppy seed tea recipe." We identified eight recipes using the following variables: cold versus hot water, ground versus whole seeds and with or without lemon. Online recipes use pounds of seeds; we scaled down to 27 g seeds, 45 mL water, and 1 mL of lemon juice. The ground seeds absorbed water so these samples used 90 mL water. All samples were shaken by hand for 5 min. Materials and methods were meant to replicate home preparation used by laypersons following an online recipe.
Results: All recipes yielded detectable morphine and codeine.
Morphine and codeine concentrations respectively:
Hot/Ground/no lemon: 247 ng/mL;89 ng/mL
Hot/whole/no lemon: 779 ng/mL;314 ng/mL
Hot/ground/lemon: 406 ng/mL;112 ng/mL
Hot/whole/lemon: 1299 ng/mL;526 ng/mL
Cold/ground/no lemon: 138 ng/mL;41 ng/mL
Cold/whole/no lemon: 785 ng/mL; 227 ng/mL
Cold/ground/lemon: 179 ng/mL;60 ng/mL
Cold/whole/lemon: 2873 ng/mL;1083 ng/mL
Discussion: Morphine and codeine were found in higher concentrations in tea made from hot water (>cold water), with lemon, and when seeds were whole (not ground).
Conclusion: Toxicologists should be aware that many recipes are readily available to people with the goal of washing narcotic alkaloids from poppy seeds. Online recipes can successfully wash morphine and codeine from poppy seeds with various results. It is apparent that whole seeds agitated in cold water with lemon give the highest yield.

008. Fentanyl Exposures: The ToxIC Experience 2010–2017

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Background: Fentanyl and its analogs are common contaminants in heroin and other illicit drugs, leading to significant overdoses and deaths. Large population-based studies of fentanyl overdoses are limited.

Hypothesis: This study aims to describe the epidemiology and clinical course of fentanyl overdoses using a large national database, the Toxicology Investigator's Consortium (ToxIC) Registry, hypothesizing that exposures are increasing and significant toxicity occurs.
Methods: Cases involving fentanyl/analogs as primary agent in the ToxIC registry between 1/1/2010 and 8/31/2017 were reviewed. Therapeutic use and withdrawal cases were excluded. Data collected included demographics, exposure state and year, outcomes, and treatment. Descriptive statistics were used.
Results: Three hundred fifty-three cases were identified. Two hundred fifty-six cases from 18 states were included. Pennsylvania (47.3%), New York (12.9%), Arizona (7.4%), Indiana (7.4%), and Massachusetts (4.7%) represented most cases. One hundred thirty-five were males. Most (88.7%) were ages 19–65 years. Two hundred nineteen (85.5%) intentional, 26 (10.2%) unintentional adult, 5 (2.0%) pediatric exploratory, and 6 (2.3%) unclassified exposures were reported. Annual exposures increased from 29 in 2010 (0.6%) to 55 by August 2017 (1.1%). Route of exposure was not reliably reported; coingestants were common. 98.4% reported signs or symptoms of toxicity. Neurologic, pulmonary, and renal data were recorded in 209, 162, and 140 cases, respectively. CNS depression occurred in 80.1%, agitation in 18.2%, delirium in 10.5%, hyperreflexia in 8.6%, and seizure in 6.2%. Respiratory depression occurred in 58.6%, aspiration pneumonia in 16.7%, and acute lung injury in 7.4%. Acute kidney injury (Cr > 2.0) occurred in 19.3% and rhabdomyolysis (CK > 1000) in 14.3%. In-hospital naloxone data were recorded in 213 cases; 77.0% received naloxone. There were seven deaths in 149 cases (4.7%).
Discussion: Fentanyl as an adulterant and a drug of abuse is increasing across the US, reflected in this national registry. Significant neurologic, respiratory, and renal toxicity is reported. Trends in large data sets such as ToxIC can better inform clinicians and public health officials in ongoing prevention, surveillance, and treatment efforts.
Limitations: Confirmatory fentanyl testing was not reported.
Conclusion: Fentanyl overdoses reported to the ToxIC registry increased from 2010 to 2017. Neurologic and respiratory symptoms, acute kidney injury, and rhabdomyolysis were common.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

009. The Predictive Value of Opioid Co-ingestion for Acetaminophen-Induced Hepatotoxicity

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Background: Abuse and misuse of acetaminophen (APAP)-opioid drugs can lead to APAP-induced hepatotoxicity, for which the Rumack-Matthew nomogram may not be applicable. We investigated APAP-opioid co-ingestion as a risk factor for APAP-induced hepatotoxicity and mortality.
Hypothesis: APAP-opioid co-ingestion will lead to more severe clinical outcomes, including APAP-induced hepatotoxicity.
Methods: A prospective cohort of APAP exposures were enrolled over 18 months at over 40 urban hospitals affiliated with one PCC. Patients were enrolled upon report to PCC and demographic, exposure, laboratory, and management data were collected. Opioid co-ingestion was identified by clinical history, opioid toxidrome, response to naloxone, and urine toxicology. The primary outcome was mortality, and secondary outcomes were transaminases > 1000 U/L or positive King's College Criteria.
Results: Out of 677 patients with APAP poisoning, 166 were APAP-opioid exposures (mean 33 years, 36% male, mean APAP 74 mcg/L, median AST 30 U/L, mean AST 369 U/L, 62% intentional self-harm, 21% multiple APAP products, 66% nomogram inapplicable), and 511 were without opioid co-ingestion (mean 33 years, 25% male, mean APAP 74 mcg/L, median AST 30 U/L, mean AST 368 U/L, 72% intentional self-harm, 2% multiple APAP products, 54% nomogram inapplicable). In APAP exposure with opioid coingestion, the most common opioid coingestion was APAP-oxycodone (36%). Fewer opioid coingestions received NAC (51 vs 61%, $p < 0.05$), or medical admission (55 vs 65% $p < 0.05$). Four cases required liver transplant, two from each group. Opioid coingestion was associated with higher mortality (2.4 vs 0.5%, $p < 0.05$), more frequent King's College Criteria (6.6 vs 3.1%, $p < 0.05$), and more frequent peak AST > 1000 U/L (16 vs 8.4%, $p < 0.01$).
Discussion: APAP-opioid coingestions were associated with worse clinical outcomes than APAP alone. This novel finding demonstrates that abuse of prescription APAP-opioid combination drugs represents a high-risk group warranting more cautious initial evaluation and clinical decision-making. Furthermore, APAP-opioid exposures received significantly less aggressive management, indicating the need for higher awareness among clinical toxicologists.
Conclusion: APAP-opioid co-ingestions are correlated with greater hepatotoxicity and mortality, suggesting the need for more intensive monitoring and treatment.

010. The Effect of Mandatory Patient Prescription History Review on Opioid Prescriptions in the Emergency Department

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Introduction: Physicians in Massachusetts are required to review a patient's prescription history prior to prescribing schedule II–III opioids. About 75% of patients who present to the Emergency Department (ED) seek care for a painful condition. We assess the impact of the mandate on ED physician prescription behavior.
Methods: We queried the electronic health record at four affiliated EDs for all opioid prescriptions written for ED patients between February 2015 and May 2017. We extracted the total number of patients discharged during this time period and the number of patients who received an opioid prescription during a repeat ED visit within 24 h. We calculated the proportion of ED patients discharged with an opioid prescription for each week during the study period and performed an interrupted time series analysis to evaluate for a change in slope or level of the prescribing trajectory associated with the mandate.
Results: Of the 209,095 issued prescriptions, 32,258 (15.4%) were for opioids for 10.9% of patients (range 5.5 to 19.2% (median 9.8, interquartile range [IQR] 5.7), with an overall downward trend observed throughout the study period (Fig. 1). Twenty-four-hour return visits ranged from 0 to 7.5% (median 2.4, IQR 3.8). The autoregressive multivariate time series model indicated no significant effect of the mandate on either slope or level shift of opioid prescribing. There was no change in 24-h return visits.
Discussion: The mandate failed to alter ED opioid prescribing patterns. Physician compliance with the mandate is unknown and unmonitored. Under-utilization may mask any potential effect. Alternatively, ED

physicians might prescribe opioids to patients with objectively verifiable painful conditions in which case even a concerning prescription history would not change outpatient therapy. Furthermore, instances in which the history alerts the physician to a patient's high-risk behavior may be rare and thus not detectable despite a large patient sample. It is reassuring that the additional administrative burden of the mandate did not result in oligoanalgesia, as 24-h return visits remained comparable pre- and post-intervention.

Day 1: Posters, Abstracts 011–058.

011. Serotonin Toxicity in Massive Loperamide Ingestion

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Background: Loperamide is a phenylpiperidine opioid anti-diarrheal that has become more prevalent as a source of recreational ingestion. It shows structural similarity to meperidine, a known 5HT-2A agonist.
Hypothesis: Loperamide may cause serotonin toxicity in overdose due to its structural similarity to meperidine and presumed 5HT-2A agonism.
Methods: Single-patient chart review.
Case: A 36-year-old man presented to an outside hospital with dizziness and syncope after daily recreational ingestion of 30–200 tablets of 2 mg loperamide. His ECG at the outside hospital demonstrated a QRS of 184 ms and a QTc of 816 ms with presumed right bundle branch block and frequent premature ventricular contractions. He was started on a sodium bicarbonate drip, IV magnesium, and transferred to our facility. On initial neurological examination, he was awake and alert with normal reflexes and no ankle clonus. He was intubated after suffering multiple cardiac arrests requiring defibrillation. He was treated with isoproterenol infusion followed by transvenous pacing. In addition to propofol for sedation, the patient was placed on a cisatracurium drip to prevent transvenous pacer dislodgement. By hospital day 2, the paralytic was discontinued, and later that day, the patient had developed hyperthermia with temperature of 39.8 °C along with lower extremity hyperreflexia and six beats of ankle clonus bilaterally. Urine gas chromatography/mass spectrometry identified loperamide, caffeine, and nicotine.
On hospital day 3, the patient's lower extremity clonus, hyperthermia, and rigidity had improved. Sedation was weaned, and he was extubated on hospital day 7 without recurrence of hyperreflexia or clonus. He was discharged on hospital day 10.
Discussion: As a phenylpiperidine derivative, structurally related to meperidine, loperamide may share the potential to cause 5HT2A agonism, which has yet to be reported. This may be an uncommon finding due to loperamide's poor blood-brain-barrier penetration and as a substrate of P-glycoprotein. No other serotoninergic compounds were reported on his medication list or identified during toxicologic screening.
Conclusion: While not seen with regular use due to poor absorption, in massive loperamide overdose, serotonin toxicity may be observed, possibly due to homology with meperidine.

012. Misinterpretation of Loperamide Artifact as a Haloperidol Metabolite in Four Cases of Loperamide Ingestion

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Background: Loperamide is an emerging drug of abuse that is associated with QRS and QTc prolongation in overdose. During urine gas chromatography/mass spectrometry testing, metabolites of haloperidol, a structurally related compound known to prolong the QTc, can be observed in individuals after large loperamide ingestion.
Hypothesis: During mass spectrometry, a loperamide artifact can be generated, which may be misidentified as a haloperidol metabolite.
Methods: This is a retrospective chart review of four individuals.
Results: For each of these cases, subjects had been chronically using large amounts of loperamide to treat opioid withdrawal, and presented with varying degrees of cardiotoxicity with QTc ranging from 500 to 813 ms. Patients had reported subacute ingestions ranging from 60 to 400 mg daily. Additionally, no patients reported haloperidol use. In all four patients, cardiotoxicity subsequently resolved in all four patients throughout the course of hospitalization without sequelae. Urine samples from each patient were analyzed via gas chromatography/mass spectrometry (GC-MS). In addition to loperamide, a haloperidol metabolite was identified in all four patients, although there was no history of home use or iatrogenic administration. The metabolite's presence was initially attributed to surreptitious haloperidol use despite patient denial. After this metabolite was identified in all four patients, additional testing was performed using a sample of loperamide injected directly into the GC column, resulting in the replication of an artifact that was also identified as a haloperidol metabolite.
Discussion: Loperamide abuse continues to increase in prevalence, typically presenting with cardiotoxicity and prolonged QTc due to blockade of the rapidly acting delayed inward potassium rectifier channel (IKr), similar to haloperidol. Loperamide and haloperidol share comparable structural similarity as well as metabolic fates due to a piperidine backbone. Based on our analysis, presence of this "haloperidol metabolite" after injection of loperamide itself is suggestive of an artifact of the process of GC-MS and is likely not a product of loperamide metabolism.
Conclusion: In cases of loperamide ingestion, a haloperidol metabolite-like artifact may be present on GC-MS.

013. Severe Treatment-Refractory Cardiotoxicity Secondary to Chronic Loperamide Use

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Background: Loperamide, a synthetic phenylpiperidine opioid, is available over-the-counter due to its reportedly low abuse potential as a function of low bioavailability. Multiple drug-exploration websites promote its use to produce euphoria or treat opioid withdrawal. In severe toxicity, cardiotoxicity has been described due to sodium and potassium channel blockade.
Hypothesis: Use of multiple supportive treatment modalities including decontamination, alkalinization, electrolyte repletion, and overdrive pacing may provide benefit in severe loperamide toxicity.
Methods: Single-patient chart review.
Case: A 36-year-old male patient with a history of opioid use disorder presented to an emergency department for evaluation of multiple syncopal events. He had been ingesting up to 400 mg of loperamide daily for approximately 1 year in efforts to prevent opioid withdrawal symptoms. On electrocardiogram, he was found to have a QRS duration of 184 ms, QTc interval of 813 ms, and recurrent episodes of polymorphic ventricular tachycardia resembling torsades de pointes requiring defibrillation. He was given a 1 g/kg dose of activated charcoal after intubation. Patient received immediate treatment with magnesium, sodium bicarbonate, and lidocaine infusions. "Overdrive pacing" initiated with isoproterenol as a bridge to transvenous pacer placement, with goal heart rate 100–120 bpm. The patient remained on lidocaine and bicarbonate infusions in addition to transvenous pacing, although he had nine additional episodes of PVT requiring defibrillation over the first three ICU days. His QRS normalized to < 120 ms on hospital day 4, and QTc to < 500 ms on day 7. Transvenous pacer was discontinued on ICU day 4. He was extubated on hospital day 6. He was discharged on hospital day 9 without permanent sequelae.
Discussion: This case report describes the use of several therapeutic modalities for the treatment of loperamide toxicity. The high doses

ingested and chronicity of ingestion makes this case unique. Additional therapeutic avenues reported in the literature that were not used in this case include intravenous lipid emulsion and extracorporeal membrane oxygenation. It is unclear if their use would have been beneficial.
Conclusion: High-dose, chronic loperamide use can be associated with treatment-refractory cardiotoxicity.

014. A Case of Loperamide Withdrawal

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Background: Loperamide is an over-the-counter antidiarrheal agent with peripheral mu-opioid receptor agonist activity. Loperamide is misused for euphoria and opioid withdrawal mitigation.
Methods: Single-patient chart review.
Case: An approximate 30-year-old male with insulin-dependent diabetes and an opioid use disorder had 2 years of excessive oral loperamide ingestion for self-treatment of opioid withdrawal symptoms. At peak, he ingested 250 loperamide 2 mg tablets/day. He self-weaned down, and 2 days prior to presentation, he ingested 140 mg but was still experiencing withdrawal symptoms, including difficulty sleeping, diaphoresis, vomiting, diarrhea, yawning, and piloerection. One day before presentation, he was started on buprenorphine/naloxone 1.4–0.63 mg tablets and took 13 tablets under the guidance of his physician. Despite the escalating buprenorphine dose, he still had persistent symptoms. Subsequently, the patient self-medicated with 100 mg loperamide and was referred to the ED. At presentation, 7 h after last loperamide ingestion, he was asymptomatic. Initial heart rate and blood pressure were 62 beats/min and 132/77 mmHg, respectively. His EKG was sinus rhythm with QRS 116 ms and QTc 556 ms. A urine drug test was positive for buprenorphine, but negative for other opioids. Loperamide level obtained 8-h after last ingestion was 41 ng/mL (reference < 5 ng/mL). A Prescription Monitoring Program review revealed no controlled medication prescriptions in the previous 2 years other than buprenorphine. He received 2 g magnesium sulfate for QTc prolongation. Clinical Opioid Withdrawal Scale scores were monitored every 4 h and peaked at 16 (moderate) on hospital day (HD) 1. He received three doses of buprenorphine/naloxone 2–0.5 mg on each HD 1 and HD 2. At discharge on HD 2, symptoms had decreased and he was maintained on buprenorphine/naloxone 5.7–1.4 mg/d after discharge.
Case Discussion: The patient previously described similar symptoms after more than 24 h without loperamide. His presentation is consistent with opioid-type withdrawal following cessation of excessive loperamide misuse. Only one other report in the literature describes potential withdrawal following discontinuation of loperamide.
Conclusion: As loperamide misuse increases, clinicians should be aware of the potential for loperamide withdrawal.

015. Lope Ain't Dope: Loperamide Abuse and the Internet

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Background: Loperamide is increasingly used for self-management of opioid withdrawal and as an inexpensive and legal method for opioid abuse. Information is available on internet search engines (ISE) and drug chat forums (DCF) about loperamide use.
Research Question: What type of information is available online about loperamide use for getting "high" and for managing withdrawal?
Methods: Three ISE (Google, Bing, and Yahoo) and DCF (Erowid, Bluelight, and Reddit) were queried for the key terms: "loperamide" plus "high" or "withdrawal." Data extracted included reason for loperamide use, dosing, recommended coingestants, and adverse effects. Advertisements and duplicate or non-functioning web URLs were excluded.
Results: A total of 293 URLs met inclusion criteria for analysis; 107 (37%) contained information on "high" and 137 (47%) for "withdrawal." The mean dose reported for "high" was 57 mg/day (40–84 mg) and 276 mg/day (2–1600 mg) on the DCF and ISE sites, respectively. The mean dose reported for "withdrawal" was 39 mg/day (0–200 mg) and 226 mg/day (2–1600 mg) on the DCF and ISE sites, respectively. The most common recommended coingestant for "high" was black pepper (2, 8.7%) and quinidine (3, 3.6%) on the DCF and ISE sites, respectively. The most common coingestants for "withdrawal" were clonazepam (3, 6.3%) and marijuana (3, 6.3%) on the DCF sites, and milk (4, 4.5%) on the ISE sites. The most common adverse effects were cardiac-related to both "high" (88, 69.3%) and "withdrawal" (69, 65.1%) on the ISE sites. The adverse effects for "high" on the DCF sites were nausea/vomiting and restlessness (both 1, 50.0%). The adverse effects for "withdrawal" on the DCF sites were restlessness, abdominal pain, insomnia, bone pain, and syncope (each 1, 20.0%).
Discussion: The data show a wide range of doses used for both abuse and withdrawal. Several websites recommended P-glycoprotein inhibitors to increase "loperamide high" effect. Cardiac effects were not reported in the DCF sites. A limitation to this study is that a convenience sample of websites may not accurately represent loperamide abuse in the general population.
Conclusion: The recommended doses for loperamide vary widely. Adverse effects are not adequately conveyed.

016. Emergency Department Patients' Perceptions of the Efficacy and Safety of Opioid Analgesics

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Background: Emergency department (ED) providers are at the forefront of the prescription opioid epidemic**.** By understanding patients' perceptions of opioid analgesics, ED providers will be equipped to counsel patients and address concerns and misconceptions.
Research Question: To determine ED patients' perception of the efficacy and safety of opioid analgesics.
Methods: Cross-sectional study of a convenience sample of adult patients recruited at a single urban, academic ED. Patients self-completed a tablet-based survey regarding their perceptions about the efficacy and safety of opioid analgesics.
Results: Of the 715 subjects recruited, the sample was predominantly black (80.4%), female (59.2%), and aged 18–59 years (76.8%). 70.1% of respondents reported pain was the primary reason for visit. 53.6% of respondents were willing to take an opioid for pain. 72% of respondents reported taking an opioid for medical use (primarily acute pain) and 62.7% of those would be willing to do so again. Of respondents who had taken opioids, 88% reported they were effective to some degree for relieving pain and 13.9% had an adverse effect to the opioid. 54% of respondents believed opioids to be either as safe or safer than non-opioid alternatives. White subjects were more likely to perceive opioids as safe and effective. There was no difference in perceived safety or efficacy based on age or gender. Although only 0.3% of respondents reported personal non-medical use, 32.4% knew someone who had a problem with non-medical use of opioids. 78% of respondents believed prescription drug abuse was a major public health problem, yet only 18.2% felt providers prescribe too many opioids and 65.6% underestimated the number of annual opioid-related deaths.
Discussion: Given high rates of prior medical use and perceived efficacy and safety, ED providers may need to address patients' expectations

regarding opioid analgesics' place in therapy. A majority of ED patients were aware of the opioid epidemic and this may be integrated into judicious prescribing efforts and pain management discussions.
Conclusion: In this study, the majority of ED patients had used opioid analgesics therapeutically and recognized non-medical use as a public health problem; however, their understanding of opioid safety and efficacy were misaligned.

017. Wearable Biosensors to Evaluate Recurrent Opioid Toxicity After Naloxone Administration

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Background: Despite extensive clinical experience with naloxone, no consensus exists on standard observation times after administration. Wearable biosensors can detect opioid effect and may be a useful adjunct in these cases.
Research Question: Can wearable biosensors detect a physiologic change consistent with recurrent opioid effect after reversal of opioid overdose with naloxone?
Methods: This is an observational trial of patients presenting to the emergency department (ED) after opioid overdose treated with naloxone. A wearable biosensor was placed on the non-dominant wrist of each participant from the time of ED arrival until one of three clinical endpoints was reached: (A) discharge from the ED, (B) admission to the hospital, or (C) 1 h post administration of a repeat dose of naloxone, if applicable. Physiologic parameters measured continuously by the sensor included heart rate, skin conductance, skin temperature, and accelerometry in three axes (*x*, *y*, and *z* axes). Physiologic data from the sensor were analyzed using a slide window technique to determine change over time after naloxone administration. Within each window, mean variance was calculated and a Hilbert transformation was applied to extract relevant features of the data (shape and scale parameters). Profiles obtained were compared pre- and post-key time points (30, 60, 90, and 120 min post-naloxone administration) and a student's *t* test was used to determine significant differences.
Results: Of the 29 participants enrolled, physiologic parameters transitioned in 73% around 90-min post-naloxone from a neutral profile to a profile consistent with opioid effect. Only three individuals received a repeat dose of naloxone; they did not appear significantly different from the remainder of the participants in transition characteristics.
Discussion: A wearable biosensor detected the cessation of naloxone activity at approximately 90 min post administration in this small population. With a low rate of recurrent naloxone utilization, we were underpowered to identify a profile predictive of recurrent toxicity requiring repeat dosing. With further research, wearable sensors may provide a valuable tool for post-naloxone monitoring both in and out of the hospital setting.
Conclusion: Wearable biosensors can detect physiologic parameters consistent with opioid effect 90 min after naloxone administration.

018. Occupational Fentanyl Exposures Reported to American Association of Poison Control Centers National Poison Data System

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Background: With deaths related to fentanyl exposures increasing dramatically in recent years, concern for the safety of first responders exposed to fentanyl in the line of duty has come into question. The most concerning possibility is that fentanyl, a highly potent opioid agonist, could poison first responders via dermal or inhalational exposure.
Research Question: Do occupational exposures to fentanyl cause opioid poisoning?
Methods: This is a retrospective review of unintentional occupational fentanyl exposures in the American Association of Poison Control Centers (AAPCC) National Poison Data System (NPDS) between January 2010 and August 2017. We extracted basic demographic data, route of exposure, most common clinical effects, clinical effects consistent with opioid toxicity (miosis, respiratory depression, sedation), administration of naloxone, and medical outcomes as defined by AAPCC. Descriptive statistics were performed.
Results: There were 163 cases of unintentional occupational exposure to fentanyl during the study period. There were 11 exposures reported in 2010, compared with 29 exposures in 2016, and 37 exposures during the first 8 months of 2017. Forty-one percent were female. Median age was 34 years. Routes of exposure were 61% dermal, 27% inhalational, 13% ocular, 11% ingestion, 6% parenteral, and 0.6% unknown. Some cases reported more than one route. The most commonly reported clinical effects were other (19%), dizziness/vertigo (13%), nausea (9%), hypertension (8%), and drowsiness or lethargy (8%). Only one of 163 cases (0.6%) reported miosis, and none reported coma, respiratory depression, or respiratory arrest. Naloxone administration was reported in one case (0.6%). Medical outcomes were as follows: 19% no effect, 23% minor effect, 4% moderate effect, 3% major effect, 7% unrelated effect, 43% were not followed. There were no deaths.
Discussion: Less than 10% of patients with occupational fentanyl exposure reported signs consistent with, but not specific for, opioid toxicity. No cases demonstrated the most clinically important sign of opioid toxicity, respiratory depression. No opioid analytics were reported.
Conclusion: Few occupational fentanyl exposures in the NPDS reported signs specific for opioid toxicity and none reported respiratory depression.

019. Sudden Sensorineural Hearing Loss Associated with Fentanyl Overdose

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Background: Sudden sensorineural hearing loss (SSHL) is generally considered hearing loss occurring over less than 72 h of at least three contiguous frequencies with most cases occurring over minutes. Although SSHL caused by opiate abuse or overuse is uncommon, it has been documented in heroin, methadone, or hydrocodone/acetaminophen with varying degrees of recovery.
Hypothesis: Fentanyl can induce SSHL.
Methods: Single-patient chart review.
Case Report: A 16-year-old male with a history of depression and experimental drug use presented to the ED after being found unresponsive and cyanotic at home. When emergency medical services (EMS) arrived, the patient was found with snoring respirations, diaphoretic, cyanotic, and unarousable. He was then ventilated using a bag-valve mask. Narcan was given at the scene, and the patient became more responsive. On arrival to the ED, the patient complained of tinnitus and inability to hear bilaterally. He was only able to communicate through writing. Patient stated that he had been snorting a gray powder (which he thought was heroin). On physical exam, the patient was somnolent, tachycardic, and had a respiratory rate of 13 bpm. Neurological exam was intact except for profound hearing loss. Initial blood tests were unremarkable, including a drug screen, salicylate, and acetaminophen levels. A comprehensive drug

screen was positive for fentanyl. A diagnostic Brainstem Auditory Evoked Response showed severe sensorineural hearing loss bilaterally. The patient was started on prednisone 60 mg daily × 5 days. He was discharged to home on hospital day 3 with significant hearing impairment.
Discussion: The differential diagnosis of sensorineural hearing loss is extensive and includes medications, organic solvents, heavy metals, structural lesions, neurologic disease, infectious etiologies, psychiatric disease, and trauma. A number of opioids have previously been reported to cause SSHL, but our case appears to be the first report attributed to fentanyl. The prognosis of patients with opioid-associated SSHL is variable, with reports of both reversible and permanent hearing loss. It is believed that cessation of the drug is the only treatment required.
Conclusion: Considering the prevalence of opioid abuse, healthcare professionals must be aware of the potential for fentanyl to cause SSHL and the possibility that the hearing loss may be irreversible.

020. High Willingness to Use Rapid Fentanyl Test Strips Among Young Adults Who Use Drugs

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Background: Synthetic opioid overdose mortality among young adults has risen more than 300% in the USA since 2013, primarily as a result of fentanyl-contaminated heroin and other illicit drugs. Rapid fentanyl test strips, which can be used to detect the presence of fentanyl in drugs (before use) or urine (after use) may help inform people about their exposure risk.
Hypothesis: The purpose of this study was to determine whether young adults who use drugs were willing to use rapid fentanyl test strips as a harm reduction intervention to help prevent overdose and if having ever overdosed would influence willingness to use rapid fentanyl test strips.
Methods: We recruited a convenience sample of young adults who use drugs in Rhode Island from May to September 2017 through Internet and bus advertisements, public canvassing, and word of mouth. Eligible participants (aged 18 to 35 with self-reported past 30-day heroin or cocaine use, injection drug use, or who purchased prescription pills on the street) completed an hour-long, interviewer-administered survey. The survey assessed participant's socio-demographic and behavioral characteristics, overdose risk, as well as suspected fentanyl exposure and willingness to use take-home rapid test strips to detect fentanyl contamination in drugs or urine.
Results: Among 93 eligible participants, the mean age was 27 years (SD = 4.8), 56% ($n = 52$) of participants were male, and 56% (n = 52) were white: 34 (37%) had a prior overdose. The vast majority ($n = 86$, 95%) of participants wanted to know if there was fentanyl in their drug supply prior to their use. Sixty-five (70%) participants reported concern that their drugs were contaminated with fentanyl. Nearly all participants ($n = 88$, 95%) reported that they planned to use the test strips.
Discussion: More than 90% of participants reported willingness to use fentanyl test strips regardless of having ever overdosed, suggesting that rapid testing is a feasible harm reduction intervention among young people who use drugs in Rhode Island.
Conclusion: Study follow-up is ongoing to determine whether, how, and under what circumstances participants used these strips, and if a positive test result contributed to changes in overdose risk behavior.

021. A Click away from Overdose: an Exposure to Furanylfentanyl Purchased on the Dark Web

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Background: The striking increase in opioid overdose deaths in Massachusetts has been largely attributed to the adulteration of heroin with high-potency clandestine opioids. Traditional analytical instrumentation is often unequipped to detect these compounds and can misguide the development of targeted public health initiatives. We report the case of an unintended furanylfentanyl exposure purchased on the dark web.
Methods: Single-patient chart review.
Case: A 23-year-old man was found unresponsive at home after insufflating 20 small doses of a white powder. EMS observed symptoms consistent with opioid toxicity and administered 4 mg of IM naloxone. Shortly after, the patient became tremulous and tachycardic, for which he received 2 mg of IM lorazepam.
Upon ED arrival, the patient's exam was notable for tachypnea, tachycardia, hypoxia, miotic pupils, slurred speech, confusion, and increased upper extremity tone. His skin displayed no stigmata of recent IV drug use. Clinicians obtained a urine specimen for further evaluation of the patient's AMS. Half of the urine specimen was sent to the CFSRE for analysis using quadrupole time-of-flight mass spectrometry coupled with ultra-high-performance liquid chromatography (LC-QTOF-MS). The remaining urine was kept in-house for a routine comprehensive drug screen using gas chromatography/mass spectrometry (GC/MS). The clinical urine drug screen (GC/MS) detected caffeine, APAP, and diphenhydramine; however, targeted confirmatory analysis via LC-QTOF-MS detected furanylfentanyl, 4-ANPP, MDMA, methamphetamine, levamisole, lorazepam, and naloxone, as well as the three compounds detected above. Following hospital discharge, the patient was contacted for follow-up and disclosed purchasing "Synthetic China White Heroin #4" from a cryptomarket on the dark web. He described each step of the process—from using an online discussion forum as an educational resource, to receiving the substance via USPS mail.
Discussion: Routine analytical testing failed to detect that this patient was exposed to a temporarily scheduled fentanyl derivative, among other substances. He experienced life-threatening effects and was subsequently hospitalized in the ICU.
Conclusion: The constantly evolving panel of novel clandestine opioids often renders routine analytical methodologies inefficient and inaccurate. Clinicians must be aware of this limitation and consider obtaining specimens for enhanced analytical analysis using reference labs equipped with investigative experts and high-powered instrumentation.

022. Incidence of Fentanyl Positivity at a Single Academic Center: Implications of Screening and Confirmatory Testing

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Background: Non-pharmaceutical fentanyl and fentanyl derivatives now commonly adulterate heroin and other drugs of abuse. Fentanyl is also increasingly a sought-after substance of abuse and an unexpected constituent of counterfeit pharmaceutical products.
Objective: To describe the prevalence of fentanyl positivity at a single academic institution among those without known exposure to pharmaceutical fentanyl.

Methods: Longitudinal study conducted at an academic urban level I trauma center of all screening (immunoassay, IA) and confirmatory (gas or liquid chromatography/mass spectrometry, GC/MS) urine drug testing over a 2-year period. Testing was identified via directed query of the electronic medical record (EMR). Evidence of fentanyl administration prior to sample collection was manually abstracted from electronic medicine administration records, outpatient prescription records, ambulance reports, and outside medicine reconciliation reports where applicable. Fentanyl was added to the immunoassay during the final 6 months of the study. Both IA and GC/MS positivity, including discrepancies, are reported.
Results: Over 2 years, 11,497 urine drug tests were analyzed. Fentanyl was added to the IA screen during the final 6 months of the study period ($n = 2771$ screening tests). Confirmatory testing was positive for fentanyl in 137 samples (1.57%) prior to addition of IA screening, and in 88 samples (3.18%) after its addition. Of all IA screens for fentanyl, 229 (8.26%) were positive. Of these, 88 (38.4%) were confirmed with GC/MS testing; 34 (38.6%) of these were unaccounted for by outpatient prescription or hospital administration. Negative confirmatory testing accompanied 141 screens positive for fentanyl (5.09% of total, 61.6% of positive screens).
Discussion: In a large single-center sample of urine drug tests, confirmed fentanyl is often unaccounted for by prescriptions and documented administration. Over half of positive fentanyl screens fail confirmatory verification. A large number of positive screens with negative confirmatory tests suggests, but does not confirm, the presence of fentanyl analogs. These findings are consistent with regional data supporting the presence of fentanyl analogs.
Conclusion: This study provides laboratory confirmation of fentanyl exposures not legitimately administered or prescribed. The large number of IA positive/confirmatory negative tests suggests the presence of fentanyl analogs in this population.

023. Intoxication Involving 4-Fluorobutyrylfentanyl and Another Unknown Fentanyl Analogue

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Background: 4-Fluorobutyrylfentanyl (4-FBF) is a designer opioid available over the Internet. Similar compounds have been previously identified by medical laboratories, but no prior detection of 4-FBF has been reported in the literature.
Hypothesis: 4-FBF produces a toxidrome similar to other fentanyl analogues, and can be detected via urine gas chromatography/mass spectroscopy (GC/MS) testing.
Methods: This is retrospective review. Data were obtained from medical records.
Results: Case 1: A 39-year-old man with a history of heroin use presented to an emergency department cyanotic and unresponsive. He became agitated after administration of naloxone, requiring endotracheal intubation. He recovered from his overdose; his urine GC/MS testing initially identified "n-allylnorfentanyl" and 4-FBF. Case 2: A 37-year-old man with a history of heroin use was found by his wife to be intoxicated. He was intubated for airway protection, but self-extubated and eloped from the hospital on the day after admission. Urine GC/MS testing also returned "n-allylnorfentanyl" and 4-FBF. Case 3: A 38-year-old woman was found unresponsive after snorting unknown "pills" and was revived with naloxone. She was discharged to home from the emergency department. Urine GC/MS testing revealed 4-FBF, 6-monoacetylmorphine, and fentanyl. Cases 1 and 2 occurred the same week; 4-FBF was detected in decedents by the local medical examiner contemporaneously with these cases.
Discussion: We describe three cases of intoxication, likely from street heroin containing 4-FBF. In two cases, a second molecule was detected which appears to be either a metabolic product or GC/MS artifact of a different fentanyl analogue. The compound "n-allylnorfentanyl" is not a metabolic product of any known fentanyl analogue. A very similar GC/MS spectrum could also result from a breakdown artifact of fentanyl (tranyl tanyl fentanyl), but that compound has no known availability over the Internet or history of detection in the heroin supply.
Conclusion: 4-FBF produces a toxidrome similar to other fentanyl analogues, and can be detected via urine gas chromatography/mass spectroscopy testing; detection and classification of fentanyl analogues poses an ongoing challenge requiring close coordination with forensic laboratories.

024. Pulmonary Complications of Opioid Overdose Treated with Naloxone

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Background: Pulmonary edema and aspiration pneumonitis have been well-described in cases of opioid overdose treated with naloxone. The incidence and association of these complications with prehospital naloxone dosing is unknown.
Hypothesis: A total prehospital dose of naloxone for suspected opioid overdose above the Pennsylvania statewide protocol maximum of 4.4 mg is associated with pulmonary complications.
Methods: We performed a retrospective study of prehospital patients treated with naloxone for presumed opioid overdose. Data were acquired from prehospital and in-hospital records from a 3-year period. We determined age, gender, naloxone dosing, Glasgow Coma Scale (GCS) prior to naloxone administration, and performance of cardiopulmonary resuscitation (CPR) or assisted ventilations. Primary outcomes were the incidence of clinical and/or radiographic evidence of noncardiogenic pulmonary edema, or a combined outcome of pulmonary edema, aspiration pneumonia, or pneumonitis. Data were described using descriptive statistics. We further explored the association of total naloxone dose above 4.4 mg with the composite outcome of pulmonary complications using chi-square analysis ($p < 0.05$).
Results: A total of 1900 cases met inclusion criteria; 1831 had hospital records available. 1224 patients (66.9%) were male with an average age of 40.7 ± 14.8 years (range 16–97 years). Median total naloxone administered was 2 mg (IQR 2, 4 mg), and 109 (6.1%) received a total dose above 4.4 mg. Median initial GCS was 3 (IQR 3, 11). Patients received assisted ventilations and CPR in 757 (41.3%) and 111 (6.1%) cases, respectively. We identified 20 cases (1.1%) of pulmonary edema and 484 cases (26.4%) of pulmonary complications in patients treated with naloxone. Naloxone dose above 4.4 mg was associated with pulmonary complications (OR 2.06, 95%CI 1.35–3.11).
Discussion: Pulmonary edema is a rare complication following naloxone administration. Combined pulmonary complications were associated with higher doses of naloxone. This association should be explored further using multivariable analysis adjusting for potential confounders and may require consideration when developing and implementing naloxone treatment protocols.
Conclusion: Noncardiogenic pulmonary edema is a rare but identifiable complication following opioid overdose treated with naloxone; pulmonary complications of opioid overdose may be more likely in patients receiving high doses of naloxone.

025. Factors Associated with Naloxone Administration in an Urban Fire EMS System

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Introduction: The Opioid Epidemic is causing increased strain on our EMS systems. Drug overdoses are the leading cause of death for Americans under 50, with two thirds of those deaths from opioids. Naloxone reverses opiate overdoses as a high affinity inverse agonist. We seek to better understand patient and external factors associated with opioid abuse to better enable the design and deployment of resources to combat this epidemic.
Methods: Data from the NEMSIS-compliant ePCR used by our urban Fire Department EMS was examined. All patients administered naloxone by EMS during a 12-month period were analyzed using Tableau. We evaluated patient demographics, patient care events, and external factors. These data were examined alongside weather, census, CDC, and county-level data.
Results: 3305 patient encounters were analyzed. Average age was 55.6 ± 13.2 for Black, and 38.2 ± 12.8 for Non-Black race. 67.9% of patients were Male. 90.4% of Blacks live in Detroit, while 51.4% of Non-Blacks live in Detroit ($p < 0.00001$). Median household income had an inverse relationship with rate of overdose events for Black patients ($p < 0.01$), but was not significant for non-Black patients. 24.6% of Black and 32% of Non-Black patients received non-invasive airway intervention (BVM, OPA, NPA). 4.7% of Black and 4.9% of Non-Black patients required invasive airway management ($p < 0.0001$). One hundred seventy-four patients (5.3%) required CPR. Peak incidence for naloxone administration was in the Fall and Winter months with a significant peak on the first of each month. Non-significant trends towards increased incidence occurred on weekends. Peak hours for naloxone administration were 10 AM–10 PM.
Conclusion: Black patients have significantly different demographics from non-Black patients. Black patients are older, live in Detroit, and overdose in their own neighborhood. Non-Black patients are younger, live outside Detroit, and predominantly overdose in Detroit neighborhoods bordering predominantly non-Black cities. Linear regression shows inverse relationship between household income and rate of overdose for Black patients, but not for non-Black patients. These demographic factors are important to understand to properly deploy EMS resources and social services to combat the opioid epidemic.

026. Determining the Range of Naloxone Dosing Required for Reversal After Suspected Heroin Overdose

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Background: Overdoses due to heroin contaminated or adulterated with fentalogs may require multiple doses of naloxone for reversal. In a fentanyl endemic area, we sought to identify the range of naloxone doses required for reversal, the relationship between increasing naloxone doses on patient disposition from the emergency department (ED), and whether there is a difference in naloxone dosing required for individuals who recently relapsed versus those who use consistently.
Methods: Electronic medical records were queried for patients evaluated at an academic, urban ED between 1/1/−12/31/2016 whose final diagnoses contained the term "heroin." Charts were included if the patient had a suspected opioid overdose, with naloxone administered by an emergency responder or clinician. Data abstracted included demographic information, vital signs, naloxone administration information, outcomes, preceding duration of abstinence, ED length of stay (LOS), and disposition from ED. To facilitate comparison of naloxone administered by different routes, we calculated intravenous naloxone equivalents (INE). The INE (e.g., 2 mg intranasal, intramuscular naloxone considered equivalent to 1 mg intravenous) of administration was calculated. Results were evaluated using descriptive and inferential statistics.
Results: Between 1/1–12/31/2016, 324 patient encounters had diagnoses containing "heroin." We used a systematic sampling frame to identify 100 charts meeting the inclusion criteria. Subjects were predominantly male ($n = 73$) and White-American ($n = 70$). Thirty-five percent of patients required at least 3 mg INE for successful reversal. $N = 52$ used heroin consistently, and $N = 24$ had recently relapsed. Average ED LOS was 4.45 ± 4.26 h.
Discussion: The average total intravenous naloxone equivalent dose required for reversal was 2.30 ± 1.39 mg. The total naloxone dose did not differ between individuals who relapsed and those who used consistently. There was no difference in ED LOS between subjects receiving < 3 mg INE, or those receiving at least 3 mg INE.
Conclusion: In this clinical chart review, at least 35% of the cases with suspected or confirmed opioid overdose required a total INE dose of 3 mg or more using a combination of routes for successful reversal, which is more than the 4 mg intranasal naloxone (2 mg INE dose) available to the public.

027. Single and Multiple Substance Opioid Exposures in Acute Care Hospitals and Emergency Departments Reported to US Poison Centers, 2011–2016

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Background: The use of opioids, rate of hospitalizations and deaths have increased over the last decade in the USA. This study aims to examine the trends in opioid exposures reported to US poison centers (PCs).
Methods: The National Poison Data System (NPDS) was queried for all opioid exposures evaluated at acute care hospitals or hospital-based EDs from 2011 through 2016. Generic codes specified by the American Association of Poison Control Centers were utilized to identify all opioids. These opioid reports were further segmented into single-substance exposures (SSE) and multiple substance exposures (MSE). Patient characteristics were descriptively analyzed and trends in exposure rates (per 100,000 exposures) were evaluated using Poisson regression.
Results: During the study period, there were 145,322 reports of opioid exposures, with SSE accounting for 38.9% calls. SSE demonstrated a higher increase in rates during the study period (38.4%, $p < 0.001$) in comparison to MSE (26.1%, $p < 0.001$). The proportion of males was higher in the SSE compared to MSE (53.1 vs 46.3%). The residence was the most common exposure site in both exposure groups (87.7 and 90%). SSE were more frequently treated and released (44.8 vs 24.7%) and less frequently admitted to the critical care unit (CCU) (24.2 vs 41.2%). Major (10.8 vs 13.6%) and moderate (31.8 vs 41%) clinical effects were less common in SSE vs MSE. The proportion of intentional opioid abuse (28.5 vs 18.4%), and misuse (9.8 vs 5.2%) was more frequent in SSE vs. MSE. In contrast, suspected suicides were more common in MSE (27.4 vs 57.9%). Drowsiness and lethargy were the most frequent clinical effects seen in SSE and MSE (42.2 and 55.7% respectively). Tramadol (29.1 and 11.7%) and oxycodone (29.8 and 20.8%) were the most frequently reported exposure agents in SSE and MSE, respectively. Intubation was reported more commonly for MSE (4.9% SSE vs 13.4% MSE), while naloxone was the more frequently reported therapy for SSE (36.4% SSE vs 32.9% MSE).
Conclusions: Among the opioid calls received by the PCs, a higher proportion reported MSE which demonstrate a greater severity of effects and higher resource utilization.

028. Comparing the Characteristics of Single-Substance Opioid and Non-Opioid Exposures Reporting Naloxone Therapy to the US Poison Centers.

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Background: As the number of deaths from opioid overdose has increased over the last two decades, several states have passed laws expanding public distribution of naloxone. This study aims to compare the patterns of opioid and non-opioid exposures where naloxone was reported as therapy to the US poison centers (PCs).
Methods: The National Poison Data System (NPDS) was queried for all single-substance exposures (SSE) where naloxone as therapy was recommended or performed from 2000 to 2016. We descriptively assessed the relevant demographic and clinical characteristics. Yearly trends naloxone therapy reports were analyzed using Poisson regression.
Results: There were 131,555 SSE reports of naloxone therapy from 2000 to 2016, with the opioids accounting for 37.9% calls. Overall, naloxone reports increased from 2000 (4038) to 2016 (12,852), despite an overall drop in poison center calls during the study period. The non-opioid calls increased by 142% during this time, while the opioid calls demonstrated a rise of 404%. The proportion of "Not Recommended but Performed" naloxone reports demonstrated a significant increase for non-opioid (57.1 to 78.1%), as well as opioid calls (55.3 to 80.7%). Opioid calls reporting naloxone therapy reported a high percentage of intentional abuse (11.1 vs 39.2%, $p < 0.001$) and major outcomes (16.1 vs 21.3%, $p < 0.001$). Non-opioid exposure cases were more commonly females (52.9 vs 41.3%, $p < 0.001$) and the proportion of teenagers was greater in this group (12.6 vs 7.6%, $p < 0.001$). The most frequent substances associated with non-opioid and opioid exposures were clonidine and heroin, respectively. The rate (per 100,000 human exposures) of non-opioid (136.9 to 320.5, $p < 0.001$) and opioid (56.3 to 274.8, $p < 0.001$) exposures reporting naloxone therapy increased significantly during the study period. West Virginia demonstrated the highest prevalence of naloxone reports for both non-opioid and opioid SSE.
Conclusions: There was an increasing trend of naloxone therapy reports during the study period. Opioid calls, specifically intentional exposures, demonstrated more severe effects. Poison centers can play a key role in determining the appropriateness of naloxone as therapy.

029. Characteristics and Predictors of Hydrocodone Misuse: Results from the 2015 National Survey on Drug Use and Health.

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Background: The abuse and diversion of prescription opioids, especially hydrocodone, continue to be a serious public health concern. The current study aims to identify predictors of hydrocodone misuse using the National Survey of Drug Use and Health (NSDUH) data.
Methods: Using the 2015 NSDUH data, the respondents were classified into two groups, past-year hydrocodone users, and misusers, based on self-reports. The prevalence of selected demographics, clinical factors as well as substance use and abuse, including prescription medications, was assessed descriptively for the two population groups using cross-tabulated frequencies and chi-square tests. Logistic regression was used to identify predictors of hydrocodone misuse adjusting for covariates. Odds ratios (OR) and corresponding 95% confidence intervals (CI) were calculated.
Results: The survey comprised of 57,146 respondents, of which 10,884 respondents (19%) reported using hydrocodone. Of these, 1812 reported hydrocodone misuse, accounting for 16.6% of the total hydrocodone users or 3.2% of the survey sample. Past-year hydrocodone misusers were more likely to be males (54.8 vs 39.9%, $p < 0.001$), unmarried (64.5 vs 40.7%, $p < 0.001$), and non-Hispanic whites (67.4 vs 66.2%, $p < 0.001$). The proportion of teenagers (11 vs 7%, $p < 0.001$), low income (22.4 vs 20.6%, $p = 0.04$), and major depression (16.4 vs 11.6%, $p < 0.001$) was greater in people misusing hydrocodone. Past-year use and misuse of substances were significantly higher in hydrocodone misusers. Previous-year use of tramadol (OR 1.66, 95% CI 1.16–2.38) and ecstasy (OR 3.05, 95% CI 1.46–6.36) were significant predictors of hydrocodone misuse. Males were 53% more likely to be hydrocodone misusers. Hydrocodone misuse was significantly more likely among misusers of other substances including sedatives (OR 3.31, 95% CI 1.57–6.97), hydromorphone (OR 3.91, 95% CI 1.04–14.64), and methamphetamines (OR 2.31, 95% CI 1.05–5.58). Conversely, previous year oxycodone misusers (OR 0.52, 95% CI 0.40–0.68) were significantly less likely to misuse hydrocodone.
Conclusions: The results indicate a high prevalence of hydrocodone misuse within a nationally representative sample of survey respondents. Use and misuse of substances were important predictors of hydrocodone misuse.

030. Buccal Buprenorphine for Stabilization of Withdrawal in Intubated Patients

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Background: Opioid use disorder is an increasingly prevalent condition with up to 4% of all hospitalized patients having this diagnosis. Opioid withdrawal is challenging to treat and can complicate stabilization of underlying injury and illness. In the ICU for example, patients in active opiate withdrawal are, in general, at higher likelihood of failing extubation. Iatrogenic dependence and withdrawal are also common in ICU patients, and patients may struggle with complicated weans and tapers. Suboxone® is the trade name for buprenorphine/naloxone (BNX) in 4/1 ratio used for the treatment of opioid dependence. In the outpatient setting, withdrawal management with BNX has been shown to be safer and less complicated than other regimens. Our team has successfully used buccal BNX for stabilization of complicated opiate withdrawal in intubated patients.
Hypothesis: BNX may be an effective treatment for withdrawal and stabilization of opioid use disorder in intubated patients.
Methods: Patient chart review of two cases.
Cases: We present two cases of patients with opioid use disorder who required ICU care related to complications from endocarditis and DKA respectively. Each required prolonged sedation weans and had failed opioid tapers due to agitation and delirium. As a means of stabilization, the patients were transitioned from IV fentanyl to buccal BNX. Following this procedure, non-opioid sedation was tapered, and the agitation and delirium resolved. Both were extubated in 2–4 days and continued on BNX, ultimately linking to outpatient programs on BNX maintenance.
Discussion: To our knowledge, the use of BNX for opioid withdrawal in ventilated patients has not been previously presented. In comparison to enteral methadone which has been described for this purpose, BNX has a preferable safety profile and can be continued in a broader range of settings. In our patients, it facilitated extubation through stabilization of withdrawal, delirium and agitation.
Conclusion: Use of BNX in opioid-dependent intubated patients may facilitate sedation wean and extubation. We present our protocol and propose more focused comparison and research in its use in the ICU setting.

031. Illuminating the Darknet: an Assessment of Opioid Users' Online Interactions Regarding Naloxone and Naltrexone

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Background: Innovative substance users turn to online cryptomarkets (i.e., the darknet) to purchase opioids and opioid antidotes. For novel users, entry into darknet sites is facilitated through websites like Reddit. Understanding darknet users' online activity with regard to opioid antidotes provides insight into how these users view opioid harm reduction.
Research Question: To describe the attitudes of Reddit users participating in popular darknet forums towards opioid antagonists for overdose prevention.
Methods: We conducted a qualitative analysis of Reddit forums (subreddits) frequented by darknet users. We used Elasticsearch to aggregate data from the subreddits "r/darknetmarkets" and "r/opiates" from May 2016 until July 2017, abstracting all posts that contained a reference to naloxone or naltrexone. We utilized a framework matrix analysis to generate themes for each individual user comment. Posts were read by two study investigators who qualitatively analyzed each comment. A third investigator reviewed cases where there was disagreement. These themes included personal experiences (separately coded as positive, negative, mixed, or neutral), information-seeking, education, access, and harm reduction.
Results: A total of 1339 comments containing references to naloxone or naltrexone were pulled from Reddit. Of these, 398 comments referenced naloxone in its application as a deterrent (e.g., in the drug suboxone), or were unrelated to the topic, and were excluded from the final analysis. Of the remaining 941 comments, the most common theme was access, representing 32.5% of all comments. The ranking of remaining themes were education (23.9%), harm reduction (20.1%), information-seeking (7.0%), neutral accounts of personal experiences (5.8%), positive personal experiences (5.5%), negative personal experiences (2.8%), and mixed personal experiences (2.3%).
Discussion: Our data show that in online communities of opioid users, discussions related to naloxone and naltrexone are primarily concerned with issues of access, closely followed by the volume of comments providing information and advice in the utilization of opioid antagonists. A high frequency of conversations related to harm reduction.
Conclusions: This study suggests that opioid users are interested in harm reduction via opioid antagonists and are concerned with issues surrounding access to these life-saving drugs.

032. Patch Problems? Characteristics and Outcomes of Transdermal Buprenorphine Delivery System Exposures Reported to the NPDS.

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Background: A transdermal buprenorphine delivery system (TBDS), marketed as Butrans, was FDA approved in 2010 for the management of moderate to severe chronic pain. TBDS has the potential to cause significant opioid toxicity due to the large amount of drug it may contain and its extended-release properties. There is little literature detailing exposures to TBDS. We sought to characterize TBDS exposures reported to the National Poison Data System (NPDS).
Hypothesis: Exposures to TBDS are associated with significant morbidity and mortality.
Methods: A cross-sectional study consisting of NPDS data collection utilizing both qualitative and quantitative data from 1/1/2010 to 1/1/2016. A qualitative analysis of NPDS fatality abstracts was conducted to characterize all human exposures to TBDS. A quantitative search in NPDS was conducted for all closed, human exposure cases to TBDS. All data entered into NPDS were collected and analyzed using Microsoft Excel (Microsoft Corp., Redmond, Washington, 2010).
Results: A total of 352 cases were identified with a peak of 92 exposures in 2012. There were 15 pediatric [mean age 7.7 years (SD 6.5)] and 337 adult cases [mean age 48.4 years (SD 16.3)]. Sixty-four percent ($n = 228$) were females, and 62% ($n = 218$) involved exposures to TBDS only. Adverse drug reaction was the most common cause ($n = 142$) for reporting, though there were 97 (28%) intentional exposures. Seventy-three percent ($n = 11$) of pediatric exposures were unintentional. Dermal exposure was documented in 240 (68%) cases. A majority of cases ($n = 190$) were managed at a healthcare facility (HCF). Seventy-nine (22%) cases were admitted to critical or non-critical care units. One hundred seventy-eight (51%) cases were followed to a known medical outcome: 16 major, 63 moderate, 78 minor, and 20 no effect. Of symptoms documented as being related to the exposure, drowsiness/lethargy was most common ($n = 90$), followed by nausea ($n = 38$). Respiratory depression was documented in 20 cases. Naloxone was given in eight cases. There was one death: a 63-year-old involving multiple substances.
Conclusions: When reported to the NPDS, TBDS exposures typically involved a single agent, were managed at a HCF, and did not result in major outcomes or death.

033. Opioid-Induced, Life-Threatening Sickle Cell Crises in a Pediatric Patient

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Background: Sickle cell disease (SCD) pain crises are often treated with opioid analgesics which may predispose to dependence and substance use disorders. The first case of a SCD patient who developed life-threatening, hypoxemic-induced vascular sequelae after surreptitious morphine ingestion is presented.
Methods: Single-patient chart review.
Case: A 13-year-old girl with SCD presented with an undisclosed morphine overdose. EMS was contacted by family after the patient would not arouse for 4 h and exhibited snoring respirations. The patient was in respiratory failure with profound hypoxemia (pulse oximetry ~ 60%) requiring endotracheal intubation. In the ED, the patient was difficult to ventilate, had continued hypoxemia, and was administered 0.8 mg IV naloxone. She immediately aroused and self-extubated with improved oxygenation. The patient remained somnolent and was admitted to PICU. Because of previous opioid-seeking behavior, she was no longer prescribed morphine preceding this admission. The patient developed acute kidney injury (AKI, Cr 1.58 mg/dL) which worsened during admission (peak 3.28 mg/dL) prompting transfer to a quaternary care center for possible hemodialysis. The AKI was treated with IVF and furosemide. Acute chest syndrome (ACS) and ARDS required endotracheal intubation. A respiratory culture detected human metapneumovirus. Post-extubation, she complained of visual changes, and brain MRI demonstrated Posterior Reversible Encephalopathy Syndrome. She was discharged on HD 3 and has had subsequent medical encounters complicated with opioid-seeking behavior. Initial admission urine LC/MS detected 170 ng/mL codeine, > 20,000 ng/mL morphine, and 551 ng/mL hydromorphone despite denial of exposure. Serum acetaminophen, salicylate, and ethanol were undetectable.
Discussion: Morphine poisoning can cause respiratory depression with ensuing hypoxemia and possible end-organ injury in non-SCD patients. However, SCD patients are predisposed to vaso-occlusive crises; thus, the

combination of opioid poisoning in this population is deadlier. Furthermore, a morphine-induced histamine release is a posited trigger for ACS exacerbation.
Conclusion: The first documented case in which opioid toxicity directly caused multiple, devastating sequelae in a pediatric SCD patient is presented. Given the current opioid epidemic, this case highlights not only the dangers of opioid poisoning in a susceptible population, but also the need to develop alternative analgesic strategies.

034. Opioid Exposures in Young Children: a Retrospective Review

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Background: Although much is published regarding the nature of adult opioid exposures, fewer data are available in young children. This study describes opioid exposures in young children and compares pediatric and adult trends to determine if these exposures correlate regionally with high adult opioid burden.
Methods: We retrospectively reviewed data on all calls involving children < 6 years old with opioid exposure reported to a single poison control center (PCC) from 2012 to 2016. A Pearson correlation coefficient was used to determine the strength of correlation between adult deaths and pediatric opioid exposures. We used publicly available data for adult deaths as a proxy for opioid burden per county, as adult opioid exposures are not comprehensively reported in our region.
Results: There were a total of 1052 cases of opioid exposure in children < 6 years old reported to the PCC from 2012 to 2016. Of the 1052 cases, 536 (51%) were reported from or sent to a health care facility (HCF). The most commonly reported symptoms were drowsiness/lethargy, respiratory depression, and vomiting. Of 536 patients presenting to a HCF, 52 (9.7%) were administered naloxone and 8 (1.5%) were intubated. One hundred ten (20.5%) showed no clinical effects. There were no deaths. The most common opioids of exposure were hydrocodone (25.4% of cases), oxycodone (20.3%), tramadol (16.7%), buprenorphine (13.5%), codeine (12.8%), methadone (4.4%), morphine (3.3%), and hydromorphone (1.7%). Exposures to buprenorphine (93% to HCF), hydromorphone (77.8%), methadone (93.5%), morphine (74.3%), and heroin (100%) were more likely to present or be sent to a HCF than children exposed to codeine (20.7%), hydrocodone (39.3%), oxycodone (56.5%), or tramadol (30.1%). The Pearson correlation coefficient between pediatric opioid exposure and adult deaths by county was calculated at − 0.05.
Discussion: Approximately one tenth of children < 6 years old required naloxone or intubation if presenting to a HCF for opioid exposure. The most frequent opioid exposures were commonly prescribed medications. Pediatric opioid exposures and adult opioid deaths did not correlate by county.
Conclusion: Although serious outcomes are less common, young children are at risk of opioid exposure requiring intervention, and more regional work is needed to aid in describing these risks.

035. Innocent Victims of the Opioid Crisis: Fentanyl Exposures in Infants and Toddlers.

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Background: Nationally, we have seen increased overdose deaths related to fentanyl and its analogs. With more fentanyl in the community, there is a higher chance of pediatric exposure. Little is known about exploratory fentanyl exposures in infants and toddlers.
Methods: Case series of pediatric opioid exposures with confirmed fentanyl on qualitative urine gas chromatography mass spectrometry (GC/MS).
Case 1: A 10-month-old boy presented to emergency department (ED) with 6 h of lethargy. Exam demonstrated bradypnea and miosis, which reversed with naloxone 0.1 mg/kg. After three bolus doses of naloxone 0.1 mg/kg over 2 h, a naloxone drip at 1 mg/kg/h was initiated at hour 11 for continued bradypnea and maintained for 13 h.
Case 2: An 18-month-old girl with history of obstructive sleep apnea presented to local ED after being found lethargic at day care. She was somnolent and demonstrated repeated episodes of bradypnea and oxygen desaturations. Infectious work up was negative. Symptoms improved 10 h after initial presentation; no naloxone was needed.
Case 3: A 19-month-old boy presented to an ED with lethargy and cyanosis. He was apneic with miotic pupils, and cardiopulmonary resuscitation was performed until confirmation of pulses. Naloxone 0.03 mg/kg was given with some improvement of mental status. He was intubated and transferred to our intensive care unit. He was successfully extubated 13 h after initial presentation to the ED.
Results: This report describes three young children with significant opioid toxicity who subsequently had confirmed fentanyl exposure on GC/MS; one required mechanical ventilation for 13 h, and one was treated with both naloxone bolus and drip for 13 h.
Discussion: These cases suggest that infants and toddlers are at risk of fentanyl toxicity, and fentanyl exposure could have serious toxicity and long duration of symptoms in this population. Further studies to better describe the clinical course of fentanyl toxicity in pediatric patients are needed.
Conclusion: With increasing amounts of fentanyl in the community, providers need to be aware of the risk for serious toxicity in young children and the potential need for aggressive management.

036. Prolonged Psychosis from a Multiple Substance Ingestion Including the Novel Psychoactive Substances Aminopropyl Benzofuran (APB) and Fluoromethamphetamine (FMA)

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Background: New psychoactive substances have become increasingly available. Two of these are aminopropyl benzofuran (APB) and fluoromethamphetamine (FMA). Unfortunately, little is known about the toxicity of these compounds, and case reports of confirmed exposures are limited.
Hypothesis: Novel psychoactive substances may cause prolonged symptoms and cardiac toxicity.
Methods: Single-patient chart review.
Case: A 19-year-old gentleman with past medical history of attention deficit hyperactivity disorder and anxiety disorder was brought in after being found walking erratically. He was unresponsive and catatonic on presentation. His mental status improved in the emergency department such that he was able to report using multiple substances including 6-APB (6-(2-aminopropyl) benzofuran) and ketamine. The next day he admitted taking 6-APB, ketamine, marijuana, etizolam, 4-fluroamphetamine, *O*-acetylpsilocin, alcohol, and possibly MDMA 4 days previously at a music festival. He had not slept for 4 days before presentation and experienced auditory and visual hallucinations. His family history included schizophrenia but he did not have any underlying primary psychotic disease. Qualitative urine testing with gas chromatography mass spectrometry for novel psychoactive substances confirmed

APB and FMA exposure. Faint systolic murmur was noted on exam yet cardiac echocardiogram 2 days after admission did not show signs of valvulopathy. Electrocardiogram was unremarkable. Serum alcohol level on admission was undetectable. He did not get any antipsychotics or benzodiazepines as treatment during admission. Due to persistent psychotic symptoms, he was transferred to a psychiatric unit. His psychosis abated after 9 days. He was discharged 11 days after presentation and he declined psychiatric discharge medications.
Discussion: We describe a case of prolonged psychosis with confirmed APB and FMA exposure, though a limitation is lack of testing for MDMA, ketamine, O-acetylpsilocin, etizolam, and cannabinoids. Fluoroamphetamine was not detected. APB has a strong affinity to 5-HT2B receptor and potentially has cardiac toxicity. Although this case did not have abnormal echocardiographic finding, more data are needed to determine the frequency of valvulopathy in APB toxicity.
Conclusion: APB and FMA can contribute to a drug-induced prolonged psychosis which is important for medical and psychiatric disposition, prognosis, and management.

037. An Outbreak of 5F-ADB Exposures Reported to a Regional Poison Center

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Background: From 9/29–10/16/2017 our regional poison center (PC) was alerted on 101 visits at a local emergency department (ED) for "K2" intoxication. Four drug samples seized by law enforcement officers from patients treated in the ED were submitted to the Novel Psychoactive Substances (NPS) Surveillance Consortium, and identified as 5F-ADB (methyl (*S*)-2-[1-(5-fluoropentyl)-1*H*-indazole-3-carboxamido]-3,3-dimethylbutanoate). 5F-ADB is an infrequently described synthetic cannabinoid receptor agonist (SCRA) resulting in transient CNS depression in users. Use has not been previously described in the USA.
Research Question: To describe the clinical effects, vital sign abnormalities, treatments, and dispositions of patients treated during an outbreak of 5F-ADB intoxication.
Methods: This is a case series. The electronic medical record (EMR) system utilized by the regional PC was reviewed to identify patients treated in the ED from 9/29–10/16/2017 for reported or suspected "K2" use. The EMRs of the ED visits were reviewed by a single abstractor to determine clinical signs and symptoms on presentation, vital sign abnormalities on arrival, treatments provided, and disposition.
Results: During the study period, 47 patients were treated in the ED for a total of 101 visits, including 43 males. The median age was 31 (21–56) years old. Tachycardia was noted on 14 (13.9%) visits, with bradycardia noted on 10 (9.9%) visits. Most patients ($n = 67$, 66.3%) presented to the ED with central nervous system (CNS) depression, 21 (20.8%) with agitation, 20 (19.8%) with "altered mental status," and 4 (4%) were confused. Seventeen (16.8%) patients required sedation for agitation. Four patients had increased secretions. Symptoms resolved prior to arrival in the ED or within 2 h of arrival in 45 (44.6%) patients. Most patients ($n = 95$, 94%) were discharged home from the ED.
Discussion: Over 2 weeks, a local ED had 101 visits for SCRA intoxication later identified as 5F-ADB. Coordinated efforts with the ED, PC, and the NPS Surveillance Consortium provided rapid identification, facilitating community education and abatement of cases.
Conclusion: A recent epidemic of 5F-ADB resulted in transient CNS depression and agitation in many users. A coordinated effort of care providers, PC, and rapid laboratory testing allowed rapid identification.

038. Phenibut Exposures Reported to a Regional Poison Center

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Background: Phenibut is a synthetically produced central nervous system (CNS) depressant that is structurally similar to the inhibitory neurotransmitter gamma-aminobutyric acid (GABA). Phenibut has been identified as a drug of abuse with CNS depression in overdose and a withdrawal syndrome with chronic use.
Objective: The purpose of this study is to report the incidence of all calls regarding the use of phenibut for one regional poison center (PC), describe the reasons for use, the signs and symptoms of phenibut intoxication or withdrawal, and outcomes.
Methods: This is a retrospective case series. Calls and patients were identified using the electronic medical record (Toxicall®) utilized by the regional poison control center. All calls regarding phenibut ingestion using the search terms "phenibut," "4-amino-phenylbutyrate," "phenitropic," "maxzzzz," "somadrol," "chill pill," "somabien," "SNS," "Happy Hippo Herbals," "PrimaForce," "PeakNootropics," "DNA Anabolics," "EST," and "HoltraCeuticals," from January 2000 through July 2017, were reviewed by a single reviewer to determine the incidence of calls, reason for calls, signs and symptoms of patients with phenibut use or withdrawal, and outcomes.
Results: There were 37 total PC calls due to use over 16 years, with an increase in calls from 2 calls in 2012 to 12 calls to date in 2017. Eighteen (49%) patients noted abuse as reason for use and 7 (19%) patients used phenibut to treat anxiety. Thirty-three callers (89%) were healthcare professionals seeking recommendations for treatment of intoxication and/or withdrawal. Eighteen (49%) patients with acute intoxication had altered mental status (AMS), 6 were intubated. There were no fatalities. Twelve (32%) patients had symptoms of withdrawal including anxiousness, tremulousness, insomnia, and tachycardia. Of note, 4 patients initially presented with AMS due to acute ingestion and subsequently developed withdrawal symptoms.
Discussion: Calls to a regional poison control center regarding phenibut have increased over the previous 5 years. Acute intoxication may result in AMS and respiratory depression and a withdrawal syndrome similar to that of other GABA agonists was described.
Conclusion: Phenibut exposures are increasing and are associated with significant clinical outcomes including respiratory failure requiring intubation.

039. Where Is My Acid? Discordance of Self-Reported Drug Ingestion Histories in Festival Attendees

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Background: Drug adulteration, dilution, and substitution have resulted in severe clinical illness. This problem is especially prevalent at music festivals because intermittent and inexperienced users are exposed to new drugs with little knowledge of what the drug is supposed to look like or how they are expected to feel after use.
Research Question: Is self-reported drug consumption discordant from comprehensive toxicology screening among festival attendees?
Methods: Sixty-three attendees from two music festivals in 2015, Arise ($n = 25$) and Sonic Bloom ($n = 28$), were enrolled. Researchers collected self-reported drug use from attendees at the festival. Urine samples were collected and comprehensive toxicology screening for > 500 illicit drugs

was performed using high-performance liquid chromatography mass spectrometry with qualitative time of flight (HPLC-MS-QToF). We determined concordance between the attendees' reported drugs and drug metabolites identified by HPLC-MS-QToF. Cases of discordance were sorted into four categories: within-drug class, outside-of-drug class, missing drug(s), and additional drug(s).
Results: Of 63 participants, 92% showed at least one form of discordance. The most common type of discordance was outside of drug class, observed in 41% of subjects. Within-class discordance was observed in 11% of subjects, missing drug(s) were observed in 19% of subjects, and additional drug(s) were observed in 14% subjects. LSD was the most commonly reported drug, while only 5.5% tested positive for LSD. Cocaine metabolites were present in 48% of subjects' toxicology screens, while only 32% of subjects reported taking cocaine. Ketamine usage was reported by 17% of subjects, but only one subject tested positive for ketamine. Cocaine and bath salts metabolites (ethylone, benzylpiperazine, benzoylecgonine, cocaethylene, and ecgonine methyl ester) were most often found in individuals that reported use of ketamine.
Discussion: There is a high rate of discordance in festival attendees. The discordance is most frequently out of class. These data may be useful in educational campaigns attempting to decrease drug use. Our analysis is limited by a small sample set and inability to control for drug use in the days immediately preceding the festival.
Conclusions: Users are not getting the drugs they believe they are buying at music festivals.

040. Rate of Ethanol Clearance in an Emergency Department Population of Experienced Ethanol Users

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Background: Ethanol-intoxicated patients commonly present to the emergency department (ED). Previous studies have determined the rate of metabolism to be approximately 20 mg/dL in an unselected group of ED patients.
Research Question: Do patients who habitually ingest ethanol have a faster metabolism?
Methods: Retrospective chart review at a large county hospital from November 1, 2014 to September 1, 2016. The group of experienced ethanol users was defined as initial alcohol level ≥ 300 mg/dL and at least one previous alcohol-related incident. Inclusion criteria: > 18 years old and at least two ethanol levels drawn in the ED separated by at least 1 h. Subjects were excluded if the second level was < 5 mg/dL. Abstracted data: age, gender, weight, blood ethanol concentrations, ALT, AST, total bilirubin (TB), magnesium, prothrombin time (PT). The clearance rate was calculated as the difference in ethanol concentrations divided by the time elapsed between levels.
Results: Fifty-eight cases were identified, 42 subjects (78.6% male, mean age 42 ± 11.4 years, mean weight 78.7 ± 17.4 kg) were included. Excluded subjects: 11 where the second level was obtained within 1 h, 3 with non-detectable second levels, 2 who were repeat presenters. Mean initial blood ethanol concentration was 373.6 ± 71.7 mg/dL (Median with IQR 358; 312; 421). Mean levels of AST 61.1 IU/L, ALT 87.9 IU/L, TB 0.8 mg/dL, magnesium 1.7 mg/L, PT 13.5 s. Mean rate of ethanol clearance was 24.7 ± 6.1 mg/dL/h (Median with IQR 24.2; 21.3–28.6).
Discussion: Previous studies have reported a wide variation in the clearance rate for ethanol ranging from 13 to 49 mg/dL/h. In our study, we defined a cohort of experienced alcohol users and found that when they presented to the ED with an ethanol concentration > 300 mg/dL, they had a mean clearance rate of 24.7 mg/dL, higher than the often cited 20 mg/dL but within the realm of previously reported data.
Conclusion: The blood ethanol clearance rate averaged 24.7 mg/dL/h in a group of experienced alcohol users who present intoxicated to the ED.

041. Trends and Risk Markers of Emergency Department Visits with Alcohol Intoxication Among Students in a Public University—a Longitudinal Data Linkage Study

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Background: Available studies of alcohol intoxication in hospital emergency departments (ED) are cross-sectional and no studies have identified patient characteristics associated with this risky drinking behavior among student populations. This study examined trends in the incidence and the demographic, organizational, academic, and clinical risk markers of ED visits associated with university student alcohol intoxication.
Methods: University admission data of 177,128 students aged 15–49 enrolled from 2009/10 to 2014/15 academic years were linked to ED visits with alcohol intoxication in the university-affiliated hospital identified using ICD-9 codes within 1 year following enrollment. Incidence rate per 10,000 person-years was calculated. Multivariable Cox proportional hazard regression was used to estimate adjusted hazard ratios (HR) (95% CI) for the association between student characteristics and subsequent ED visits with alcohol intoxication.
Results: There were 889 students having at least one ED visit with alcohol intoxication over a total 151,414 person-years follow-up. The overall incidence was 59/10,000 person-years. There was a linear increase in the incidence from 45/10,000 person-years in 2009–10 to 71/10,000 person-years in 2014–15 academic year ($p < 0.001$). The incidence decreased linearly with age: 129 in students aged < 20 years, 52 in ages 20–24, 10 in ages 25–29, and 1 in ages 30–49 ($p < 0.001$). HRs (95%CIs) of student characteristics associated with ED visits with alcohol intoxication were as follows: males (versus females): 1.38 (1.21–1.58); below 20 years of age (versus 25–30 years): 3.36 (1.99–5.65); Hispanic (versus Asian) students: 1.61 (1.16–2.25); parental tax dependency: 1.49 (1.16–1.91); Greek life member: 1.96 (1.69–2.26); member of an athlete team: 0.51 (0.36–0.72); undergraduate versus graduate students: 2.65 (1.88–3.74), and first enrollment: 1.92 (1.65–2.25). Prior alcohol use or having been diagnosed with depression or anxiety was also significantly associated with higher risk for ED visits with alcohol intoxication.
Conclusion: Linking student admission data with subsequent ED clinical data can monitor the trend in incidence of alcohol intoxication in the student population and identify students at higher risk who should be targeted through screening, enhanced counseling, and timely referral to available education and preventive services.

042. Drinking Among High-Risk Students Receiving the Brief Alcohol Screening and Intervention in a Public University in the USA

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Background: Alcohol abuse in the collegiate population continues to be a significant problem. This study examined knowledge and experience of high-risk students receiving the brief alcohol screening and intervention of college students (BASICS) with the negative effects of excessive drinking in a major public university in the USA.
Methods: Questionnaire-based interviews were administered to students prior to the BASICS session during 2016–2017 academic year. Data on students' demographics, frequency and amount of drinking, knowledge on the effects of alcohol use, experience with negative effects of excessive drinking, and their perceptions of alcohol use among college peers was descriptively analyzed.

Results: A total of 122 students (75% males) visited the BASICS clinic. The median age was 19 (77% younger than 20) with 44% freshmen, 27% sophomore, 43% fraternity or sorority affiliated; 13% athletic team members. The median age of first-time alcohol consumption was 17. Nearly two thirds (61%) of students reported frequently drinking alcohol and 55% reported frequently having ≥ 6 drinks on one occasion. Nearly half reported having three or four alcoholic drinks on a typical day when drinking. On average, male and female students estimated that 14 and 5% ($p < 0.05$), respectively, of their peers of the same gender drink more. Students reported failing to do something (66%), feeling of guilt (78%), reduced memory (83%), and feeling bad (70%) following their drinking. Furthermore, 92% ever felt sick, 77% ever felt tired, and 24% ever had an injury. A significant proportion of students reported problems with study due to their alcohol use: 25% doing poorly on the test, 53% not getting things done, 26% missing class. A significant proportion of them reported risky behavior under the influence of alcohol: 83% trouble with police, 53% fight or argument, 46% passing out, 25% unwanted sex, 11% drinking driving; they also had problems with family (30%) and partners (27%).
Conclusion: The majority of students reported negative physical and mental consequences of risky drinking. Findings indicate that timely referral of such high risk students to BASICS could mitigate the risk and requires further study.

043. Amphetamine and Clonidine Toxicity Resulting in Posterior Reversible Encephalopathy Syndrome (PRES)

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Background: Amphetamine toxicity typically presents with hypertension and tachycardia. Conversely, clonidine acts as an agonist at central α_2 as well as imidazoline receptors, which may cause brief initial hypertension followed by hypotension and bradycardia in overdose. We report a unique case of a mixed ingestion involving these two agents.
Methods: Single-patient chart review.
Case: A 17-year-old male presented with mild nausea and fatigue 2 h after reportedly ingesting 15–25 clonidine 0.1-mg tablets and 15–25 dextroamphetamine 10 mg extended-release (ER) capsules in attempted self-harm. Triage vital signs were temperature 36.4 °C, blood pressure (BP) 145/95 mmHg, heart rate (HR) 52 beats per minute (bpm), and oxygen saturation 100%. Nine hours post-ingestion, the patient developed headache, photophobia and confusion with a BP 182/111 mmHg and HR 48 bpm. Head CT revealed downward migration of cerebellar tonsils, full posterior fossa, and a small fourth ventricle, findings suggestive of PRES. An amphetamine level obtained 4 h post-ingestion was 133 ng/mL (reference C_{max} 23.5 ng/mL). Clonidine levels at 4 and 12 h post-ingestion were 9.9 and 20 ng/mL, respectively (therapeutic level 0.4–3.85 ng/mL). The patient's systolic BP continued to rise to the 200 s mmHg and was treated with 2 mg of phentolamine intravenously at 14 h post-ingestion. Within 2 min, his BP decreased to 133/82 mmHg and HR increased to 56 bpm with reported improvement of headache and nausea. Repeat doses of phentolamine were given 4 and 9 h later with transient 10–15mmHg decreases in BP and 5–8bpm increases in HR. A nicardipine infusion of 1 mg/h was started and titrated up to 2.5 mg/h for a total of 12 h. The patient was stable with normal vital signs at 36 h post ingestion.
Discussion: The unique presentation may have been due to delayed actions of ER dextroamphetamine and the α_2-agonistic effects of clonidine. Phentolamine was chosen for its α_1-adrenergic antagonism and was effective in managing symptoms.
Conclusion: This patient developed hypertensive emergency, bradycardia and PRES following ingestion of clonidine and dextroamphetamine with confirmatory serum levels.

044. Synthetic Cannabinoid Exposure in Adolescents Presenting for Emergency Care

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Objectives: To characterize the clinical picture and management of synthetic cannabinoid exposure in a cohort of adolescents.
Methods: Using the 45 participating sites of the Toxicology Investigators Consortium (ToxIC) Registry, a North American database, we conducted an observational study of a prospectively collected cohort. We identified all adolescent (12–19 years) cases of synthetic cannabinoid exposure who have received medical toxicology consultation between January 2012 and December 2016. Clinical and demographic data were collected including age, sex, circumstances surrounding exposure, co-ingestants, clinical manifestations, treatment, disposition and outcome.
Results: We identified 75 adolescents who presented to the emergency department with synthetic cannabinoid exposure. Most were male (91%) and between the ages of 16–19 (66%). The most common symptoms were neuropsychiatric with 50 adolescents (67%) exhibiting central nervous system (CNS) manifestations. There was no predominant toxidrome, and nine (12%) patients required mechanical ventilation. Mainstay of treatment was supportive care. No deaths were reported.
Conclusions: Synthetic cannabinoid exposure in adolescents is primarily characterized by CNS manifestations, which are varied and may be life-threatening. Frontline caregivers should maintain a high index of suspicion for synthetic cannabinoids, especially in adolescents who present with unexplained CNS manifestations, as there is no specific toxidrome or confirmatory rapid drug screen to detect them.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

045. Sympathomimetic Toxicity from "Rainbow Diet Pills"

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Background: In the 1940s, amphetamine and desiccated thyroid were popularized as diet aids and combined with atropine, barbiturates, benzodiazepines, or digoxin to reduce sympathomimetic effects. Marketed as "Rainbow Diet Pills" due to bright coloring, they were outlawed by the FDA in 1968 due to multiple deaths.
Methods: Two cases of toxicity from the rainbow diet pill Redotex® containing D-norpseudoephedrine 50 mg, diazepam 8 mg, atropine 0.36 mg, aloin 16 mg, and triiodothyronine 0.075 mg are described.
Cases: Case 1: A 25-year-old suicidal woman ingested 20 capsules of Redotex®, 500 mg sumatriptan, 2 ibuprofen tablets (dose unknown), and 2 unknown diet pills. She reported chest pain, nausea, headache, and dizziness, with initial HR 150 bpm, BP 170/65 mmHg. She received 50 g charcoal, 1L NS and antiemetics. EKG showed sinus tachycardia

with normal intervals without ischemia. Treatment included 30 mg diazepam and an esmolol drip, with transition to oral metoprolol 25 mg BID for agitation, hypertension, and tachycardia. Urine GC/MS showed atropine/hyoscyamine, metoprolol, and pseudoephedrine/ephedrine. Total T3 on hospital day (HD) 2 was 239 ng/dL (normal 80-200 ng/dL). On HD4, toxicity resolved.
Case 2:: A 17-month-old 13.4-kg boy presented with insomnia, fussiness, and agitation after ingesting 1.5 capsules of Redotex®. He received midazolam 1.3 mg and IV fluids for agitation and tachycardia. Tachycardia persisted for 3 days, peaking at 201 bpm. Additional IVF and 6.5 mg diazepam were used to control sympathetic excess. Atropine, hyoscyamine, caffeine, norpseudoephedrine, and polyethylene glycol were detected on urine GC/MS. On HD2, TSH was 0.08 uIU/mL (normal 0.741–5.24 uIU/mL) and free T3 was 3.9 pg/mL (normal 1.6–6.4 pg/mL). He was discharged home on HD3.
Discussion: Rainbow diet pills, though dangerous, are available abroad and brought to the USA. Not only are many of the ingredients toxic, these products are often poorly manufactured and consumers are inadequately informed of their contents. Physicians should be familiar with appropriate evaluation and management of Rainbow Diet Pill toxicity including sympathomimetic signs and abnormal thyroid studies.
Conclusion: Though banned by the FDA, combination diet pills are readily available and can cause significant toxicity in the setting of accidental or intentional ingestion.

046. Subacute Combined Degeneration Following Chronic Nitrous Oxide Use

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Background: Nitrous oxide is used both as an inhalational anesthetic and a food additive to create foam, a property commonly exploited to make whipping cream. Chronic inhalational use of nitrous oxide produces a number of complications including neurologic effects representing a syndrome of functional vitamin B12 deficiency. We present a case of a patient using nitrous oxide and developing subacute combined degeneration (SCD) after 6 weeks of daily use.
Methods: Single-patient chart review.
Case: A 37-year-old man with no past medical history presents with a 4-day history of loss of fine motor control, difficulty walking, writing, numbness and tingling. He reports a 6-week history of inhaling nitrous oxide which he purchased on the street. His vital signs were normal. His physical exam was significant for diminished sensation of lower extremities, worse distally, impaired proprioception of the distal extremities and ataxic gait. His labs were significant for a macrocytic anemia with a hemoglobin of 12.6 g/dL, MCV of 109.9 fL, a vitamin B12 level of 874 pg/mL (243–894 pg/mL), a homocysteine level of 22.4 (5.0–15 umol/L) and a methylmalonic acid level of 1243 (0–378 nmol/L). His CT/LP was negative for alternative diagnoses. He was administered high-dose vitamin B12 1 mg intramuscularly and folic acid 1 mg. During hospital day 2, the patient's MRI cervical spine showed a T2 hyperintense signal within the dorsal columns of the cervical cord at C3–C5 levels. He was discharged on hospital day 4 with no improvement of symptoms and will continue to receive outpatient vitamin B12.
Discussion: SCD is an uncommon presentation of chronic nitrous oxide use. The mechanism by which this occurs is via inhibition of methionine synthase by irreversibly oxidizing cobalt ion of cobalamin from the + 1 to the + 2 valence state. This prevents the production of methionine and s-adenosylmethionine synthase which is required for the methylation of myelin sheaths and phospholipids. High-dose vitamin B12 may improve symptoms; however, in some chronic users, neurologic symptoms may become permanent. Nitrous oxide abuse is still prevalent today. It is important to consider SCD as a possible complication of such abuse.

047. Prolonged Methylphenidate Toxicity Treated with Continuous Dexmedetomidine Infusion

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Background: Extended-release methylphenidate is used to treat behavioral disorders in children and adolescents, and in overdose can cause prolonged sympathomimetic toxicity with extreme agitation and autonomic instability. While this toxidrome has historically been treated with GABA-agonist medications such as benzodiazepines, the central sympatholytic agent, dexmedetomidine, has been successfully used to treat the sympathomimetic toxidrome with short courses to treat immediate-release methylphenidate toxicity.
Hypothesis: Prolonged continuous infusion of dexmedetomidine successfully abolishes the central sympathomimetic agitation and increased adrenergic tone secondary to extended-release methylphenidate toxicity.
Methods: Single-patient chart review.
Case: A 15-year-old boy overdosed on methylphenidate in a suicide attempt. He took unknown amounts of 5 mg immediate-release and 36 mg extended-release preparations. He initially presented asymptomatic to a community hospital and was transferred to a tertiary care center within 6 h of the overdose. At presentation to the tertiary emergency department, he had normal vital signs with clear sensorium and was admitted for monitoring. Nine hours after ingestion, he developed severe agitation, tachycardia, and hypertension. He received escalating doses of intravenous benzodiazepines (7 mg midazolam, 17 mg lorazepam, 20 mg diazepam) and antipsychotics (10 mg haloperidol) within a one h period and required hard restraints. He was transferred to the ICU and was started on a dexmedetomidine infusion at 0.2 mcg/kg/h which ameliorated his symptoms. He was maintained on the drip for 19 h with no further sedation requirement or physical restraints and then stopped. He did not require endotracheal intubation.
Discussion: Extended-release formulation methylphenidate has potential to cause a prolonged sympathomimetic toxidrome requiring frequent dosing of sedative agents. This patient demonstrated a delayed and prolonged severe sympathomimetic toxicity despite treatment with benzodiazepines and a first-generation antipsychotic. His toxicity was controlled with dexmedetomidine, a central alpha-2 and imidazoline receptor agonist. Dexemedetomidine represents a direct treatment modality as a central sympatholytic that abolishes central sympathomimetic effects without causing airway compromise and has the additional benefit of being rapidly titratable without significant sedation or residual effect.
Conclusion: Continuous dexmedetomidine is an effective treatment for prolonged toxicity secondary to extended-release methylphenidate.

048. Nimetazepam (Happy 5): New Drug of Abuse?

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Background: Nimetazepam is a long-acting benzodiazepine, brought to the market under the trade name Erimin in Japan in 1977. It has rapidly become a popular drug of abuse in Asia. In Malaysia, it is now the most commonly misused sedative. It may be referred to as "Happy 5", a reference to the number 5 imprinted on the tablets, and indicating the dosage in milligrams of nimetazepam. Currently, it is not legally sold in the USA and very little information exists about its use outside of Asia.
Methods: Single-patient chart review.
Case: A 46-year-old HIV-positive male with a long-standing history of intranasal ketamine use presented to the emergency department (ED) after being found unresponsive in his backyard by family. On presentation, his vital signs were unremarkable. His Glasgow coma score was 3. He was intubated for airway protection. Non-contrast computed tomography of the head was normal and urine toxicology screen was positive for

benzodiazepines. He was admitted to the intensive care unit (ICU) and extubated the following day, at which time he was neurologically intact and fully oriented. Further history obtained from patient revealed that he had used "Happy 5" for the first time. He denied recent use of other illicit drugs. Gas chromatography mass spectrometry analysis performed on urine and serum from presentation revealed nimetazepam, ketamine and norketamine in urine and ketamine, norketamine, nitrazepam and nimetazepam in serum.
Discussion: There is very little information in the literature on the pharmacokinetics or metabolism of nimetazepam. Existing literature often discusses nimetazepam in conjunction with nitrazepam, a desmethyl derivative with similar effects. Nimetazepam is more rapidly distributed and has higher concentrations within the brain when compared to nitrazepam. Illicitly manufactured tablets of "Happy 5" have been found to contain either pure nimetazepam, or a combination of nimetazepam with another benzodiazepine, notably diazepam or nitrazepam. This may explain why nitrazepam was detected in the patient's serum.
Conclusion: We describe a case of nimetazepam used for recreational purposes in the USA confirmed by gas chromatography mass spectrometry.

049. Gamma Hydroxy-Butyrate (GHB) Overdose: a Descriptive Analysis of Patients Presenting with Altered Mental State and Factors Associated with Intubation.

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Background: Glasgow coma score (GCS) less than 9 is often used to decide to intubate in the emergency department (ED). We analyzed suspected GHB intoxications presenting to our ED-network, with GCS < 9 and compared clinical features of intubated (INT) and not intubated (non-INT) patients.
Method: Retrospective analysis of presentations with suspected GHB intoxication (Jan 2013–Jan 2017). Data included demographics, co-ingestants, ethanol intake, physiological and blood gas parameters on presentation, lowest GCS, intubation status, and length of stay (LOS). Continuous data reported as median (range) or mean (95% CI).
Results: There were 332 suspected GHB presentations (280 non-INT and 52 intubated). GCS < 9 documented in 78 non-INT and 51 INT patients. Median age was 25 years for both cohorts. GHB was suspected on presentation (non-INT 88 vs INT 94%) with similar incidences of poly-drug (40 vs 39%), amphetamine (30 vs 37%), and ethanol co-ingestion (32 vs 33%), respectively. Median serum-ethanol concentration: non-INT 0.015 vs INT 0.02 mg/dL. Initial venous blood gases showed similar mean serum pH: non-INT 7.32 (95% CI 7.31–7.34) vs INT 7.30 (95% CI 7.28–7.32) and mean pCO_2 non-INT 50.5 mmHg (95% CI 48–52) vs INT 50 (95% CI 47–51). Median lowest GCS for non-INT 7 (3–8) vs INT 3 (3–8), $p < 0.0001$. Presenting pulse and BP were similar. Median time to intubation from ED presentation was 22 min and those intubated were vomiting more frequently (23 vs 13%, $p = 0.15$, OR 2.1, 95% CI 0.83–5.3) and more commonly had a subsequent cranialCT (86 vs 9%, OR 64, 95% CI 21–194). Cranial CTs were all normal. Median time to extubation was 7 h (2.5–40) vs non-INT patient time to GCS 15 2.5 h (0.5–16), $p < 0.0001$. Median total LOS: INT 24 h (4–123) vs non-INT 5.0 h (0.5–84), $p < 0.0001$. Median peak propofol infusion rate while intubated was 200 mg/h (50–500).
Conclusion: GCS was the only significantly different clinical parameter on presentation between intubated and non-intubated patients. Once intubated, patients more commonly underwent cranial CT scanning. Intubation duration may have been prolonged in some patients as evidenced by high peak propofol infusion rates, possibly to faciliate extubation in daylight hours.

050. The Path Forward: Substance Use Disorder Evaluations (SUDE) in the Emergency Department

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Background: In July 2016, Massachusetts enacted legislation requiring all patients presenting to emergency departments (EDs) after an opioid overdose be offered a Substance Use Disorder Evaluation (SUDE), a behavioral health intervention that identifies patterns of substance use, determines appropriate levels of addiction care, and motivates patients to pursue treatment. We sought to investigate the acceptance and effect of SUDE during its implementation in our ED.
Methods: A retrospective chart review was performed at a large, urban, academic ED. Electronic medical records were queried using the terms "overdose" and "heroin." Charts were categorized as pre-implementation (PRE, 6/1/2015–6/30/2016) or post-implementation (POST, 7/1/2016–2/28/2017), then selected for analysis using systematic random sampling methodology. Data abstracted included whether a patient received a SUDE, ED disposition, length of stay, and repeat visits for opioid-related complaints.
Results: PRE included 58 cases; POST included 71 cases. POST was subdivided into two groups: patients who received a SUDE (SUDE+, $n = 15$) and those who did not (SUDE−, $n = 56$). None of the SUDE− cases were dispositioned to addiction treatment programs (PRE = 8.5%, SUDE+ = 6.9%, SUDE− = 0.0%). The SUDE− group had the highest percentage of cases where the patient eloped or left against medical advice (SUDE− = 28.8%, PRE = 15.3%, SUDE+ = 10.3%). Median length of stay was 5 h 11 min for SUDE+ versus 2 h 13 min for SUDE−. 17.2% of SUDE+ patients had ≥ 1 subsequent visit for an opioid-related complaint within three months of initial encounter, compared to PRE (23.7%) and SUDE− patients (21.4%).
Discussion: A minority of eligible patients actually received a SUDE. Longer length of stay may discourage patients from accepting the SUDE, or result in patients eloping before receiving it. Patients who received a SUDE were less likely to have an ED visit for an opioid-related complaint in the following 3 months, although disposition to detox facilities does not appear to differ. Limitations include small sample size and retrospective, single-center methodology.
Conclusion: SUDE is a novel behavioral health intervention that seeks to enhance ED-based overdose care. Potential barriers, such as delay to SUDE and obstacles to entering treatment, must be identified and addressed to optimize acceptance by its target population.

051. Pregabalin as a Drug of Abuse and Toxicologic Cause of Seizure

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Background: Pregabalin is a GABAergic medication with a variety of indications including migraines, neuropathic pain, adjunctive therapy for epilepsy, and fibromyalgia. Structurally analogous to gabapentin, it appears to act through inhibition of presynaptic calcium channels, inhibition of glutamate release, and GABA agonism. It is an increasingly common drug of abuse and descriptions of its effects in overdose vary. Known effects of pregabalin in overdose include drowsiness, dizziness, tremors, and muscle twitching. Pregabalin as a cause of seizures has rarely been reported.
Methods: Single-patient chart review.
Case: A 37-year-old man with a history of substance abuse who was brought in by a friend after recreational ingestion of about 20 tabs of

200 mg pregabalin. His friend described generalized tonic-clonic activity with urinary incontinence. In the ED, the patient had normal vital signs, was drowsy but oriented, and his exam was notable only for urine soaked clothing. His friend at the bedside was noted to be falling asleep, and admitted to taking another dose of pregabalin. He had a nearly empty bottle of pregabalin 200 mg filled the day of presentation, prescribed to him. He was also registered as a patient due to his evident intoxication. Aside from drowsiness, his exam was benign and he had normal vital signs. Both patients had extensive diagnostic testing which did not reveal an alternate cause of their symptoms. A urine pregabalin level on the initial patient was greater than 10,000 ng/ml, the upper limit of the assay (normal < 1000 ng/ml). Urine drug screens were positive for opioids in both patients, consistent with their known history of opioid abuse. Both patients were observed overnight due to their prolonged somnolence. They were both discharged the next morning without further event and back to their baseline mental status.

Discussion: Although structurally similar to gabapentin and a functionally GABAergic medication, pregabalin has been implicated as a cause of seizures in acute overdose. Perhaps explaining this difference is pregabalin's high oral bioavailability and lack of saturable transport protein. Pregabalin abuse has been more frequently reported, especially in concomitant opiate abuse, and should be included in the differential of toxicologic seizures.

052. Delays During the Administration of IV *N*-Acetylcysteine for Acute Acetaminophen Poisoning Were Not Associated with Worse Outcomes

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Background: Prompt administration of *N*-acetylcysteine after single acute acetaminophen ingestion is remarkably effective in preventing the development of acetaminophen-related hepatotoxicity. Many institutions now primarily use the 21-h intravenous protocol with the FDA-approved Acetadote® product. Dosing recommendations are for continuous infusion of the three different bags (150, 50, and 100 mg/kg) for a total of 21 h. What is unclear from the literature is if there is a delay during the infusion, how long of a delay is significant and does it portend a worse outcome?

Methods: A retrospective chart review of all patients receiving IV *N*-acetylcysteine for acute acetaminophen ingestion over a 3-year period. Charts were excluded if the patient had a non-toxic level of acetaminophen or if the infusion was stopped before conclusion. Pregnant women, children, those with pre-existing liver disease, and repeated supratherapeutic ingestions of acetaminophen were excluded.

Data were abstracted by the author. The recorded times of initiation of each part of the infusion were recorded, and based on the start time, the expected time of initiation of the next part of the infusion was calculated. A delay of > 30 min between the different bags of the infusion was considered significant.

Results: A total of 34 charts were identified. Seven were excluded for incomplete infusions; 1 was a repeated supratherapeutic ingestion, and 1 was transferred during the infusion. Of the remaining 25 charts, there were 8 in which a delay of at least 30 min occurred during one part of the infusion; in one patient, there were two delays totaling 168 min. The longest single delay was 154 min for one patient. In none of the eight patients did hepatotoxicity or any other signs of acute liver injury develop. Length of stay was not affected in the delay patients versus those who did not experience a significant delay in their infusions.

Conclusion: In our study, delays of up to 2 ½ h during the infusion of *N*-acetylcysteine did not result in any obvious adverse outcome. A much larger observational study will be needed to confirm these results.

053. Evaluation of Cost and Use of Intravenous *N*-Acetylcysteine One-Bag Method for Acetaminophen Overdose

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Background: The United States Food and Drug Administration (FDA) approved intravenous *N*-acetylcysteine (NAC) for the use of acetaminophen overdose in 2004. Package insert dosing recommends a three-bag infusion method with a loading dose of 150 mg/kg over an hour followed by 50 mg/kg over 4 h and 100 mg/kg over 16 h. At the University of Virginia Health System (UVA), a one-bag method, 30 g/1000 mL is used with a bolus dose of 150 mg/kg over 1 h followed by 14 mg/kg/h for 20 h.

Hypothesis: Is the current NAC one-bag method wasteful? Does the current method reduce administration errors?

Methods: This is a retrospective, chart review of patients presenting to a tertiary medical center. A search of the hospital's electronic medical record (EMR) was conducted, January 1, 2015 to August 31, 2017, to identify all patients started on NAC in the emergency department (ED) for acetaminophen toxicity. Patient's infusions were followed throughout the hospital stay to determine the amount infused and amount of medication wasted, and if the bolus was administered. Descriptive statistics was used for all data collected.

Results: There were 64 patients with acetaminophen overdose who received NAC. The average age was 30.6 years and average weight was 71.5 kg. The average amount of NAC administered was 25 g and the total amount of waste in dollars accumulated over the 3.5-year time period was $15,750 (average cost per patient of $246). No patients required liver transplantation. Four patients failed to receive the NAC bolus due to administration error. Two of these patients did develop mildly elevated transaminases.

Discussion: The cost of NAC wasted was less than hypothesized and UVA would like to continue the one-bag method. The four cases that missed the NAC bolus coincided with the hospital's change in pump software. Before this software change, no cases were documented as missed boluses. Findings of patients missing the bolus will lead to order changes for NAC.

Conclusion: There was limited waste from the single-bag method. There were few administration errors associated with the single-bag method.

054. The Hepatoprotective Effect of *N*-Acetylcysteine with Repeated Toxic Acetaminophen Ingestions: a Case Report

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Background: It has classically been taught that a patient with acetaminophen toxicity will not have any continued liver dysfunction after recovery from an initial acute insult. Despite this notion, there has not been a case reported in the literature of recurrent acute acetaminophen (APAP) overdose with known time of ingestion.

Methods: Retrospective chart review of one patient who presented 27 times after large acute acetaminophen ingestion, receiving *N*-acetylcysteine (NAC) 20 times, without residual signs of liver dysfunction.

Methods: The patient's electronic medical record (EPIC®) was reviewed at patient's preferred hospital site as well as the Minnesota Poison Control System (Toxicall®) to identify total number of ingestions, serum APAP level, administration of NAC, and subsequent laboratory results. Serial liver function tests and acetaminophen levels were analyzed to attempt to determine induction of metabolism.

Results: All presentations were very similar: witnessed by employees at her group home, presented about 1 h after ingestion, and ingested 25 g of APAP (50 tablets of 500 mg; not extended-release). The patient received NAC 20 times over a 9-year period due to a toxic 4-h serum APAP level; 13 times in a 6-month period.
Despite the repeated toxic acetaminophen insults, there were no residual signs of liver dysfunction. Her aspartate aminotransferase (AST) and alanine aminotransferase (ALT) never reached 40 IU/L. One time, her INR increased to 2.3 the day after a 4-h serum APAP level of 355 mcg/mL, the highest APAP level recorded for this patient. Otherwise, INR was never greater than 1.2.
Discussion: This patient was repeatedly witnessed ingesting a potentially hepatotoxic dose of acetaminophen with numerous serum levels above the standard Rumack-Matthew nomogram line. This case illustrates the long-taught concept that there is no residual liver damage if an APAP overdose is adequately treated with *N*-acetylcysteine and patient reaches stage IV of APAP toxicity. It also provides tangible evidence that repeat toxic ingestions do not have a cumulative effect.
Conclusion: This case report demonstrates the intrinsic and repeated hepatic reparative properties as long as the liver is allowed to heal between insults.

055. Teaching About Acetaminophen Overdose Using Animated Video Versus Assigned Reading

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Background: Advances in technology have brought with them innovations in delivery of medical educational content: podcasts, flipped classroom learning, and iBooks. These new modalities may be useful for delivery of asynchronous content.
Hypothesis: Is an animated video as effective as assigned reading in teaching students about treatment of acetaminophen overdose?
Methods: This is a randomized controlled trial of medical students watching an animated educational video. A 4:33-min animated educational video was created using VideoScribe® software. Students were given a pre-test to assess knowledge about treating acetaminophen overdose. Students were randomized to either read a chapter on acetaminophen overdose from a core emergency medicine textbook or to view the video; they were then given the post-test and the preferences survey. The results were categorized and analyzed using descriptive statistics.
Results: Sixty-nine students participated in the survey, 14 of whom did not complete the full survey, leaving 55 instances which were included in the final analysis. Twenty-three students were randomized to reading the textbook chapter and 32 were randomized to viewing the video. The pre-test averages were 44.4 and 58.9% while the post-test averages were 69.6 and 85.8% for the textbook and video groups respectively. An older cohort of students was randomized to the video group (5 more MS2 students, 3 more MS4 students). 78.4% of students expressed a preference for watching a video over reading a textbook chapter, while 98% of students either agreed or strongly agreed with the statement that they would be comfortable using the internet to learn new concepts. Fifty-seven percent of students reported being satisfied reading the textbook chapter and no students reported that they were very satisfied, while 93.3% were either satisfied or very satisfied viewing the video.
Conclusions: Both textbook and video are effective modalities for the delivery of educational content; however, video delivery was associated with higher student satisfaction with the educational activity. Students overall expressed comfort using the internet and new technology to obtain new medical education.

056. Endotracheal Intubation: High Risk in Salicylate Toxicity, Ultra-High Risk in Unrecognized Salicylate Toxicity

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Background: The clinical findings of salicylate poisoning are typically recognizable in an alert patient. However, in patients with altered mental status (AMS) these findings may lead providers to pursue alternative diagnoses, such as sepsis, with potentially dangerous consequences.
Hypothesis: In patients with unexplained AMS undergoing endotracheal intubation (ETI), a serum salicylate concentration should be considered.
Methods: Single-patient chart review.
Case: A 65-year-old man with a history of alcohol abuse and COPD was brought to a university medical center ED for AMS. There was no known history of overdose. Home medications included lamotrigine, baclofen, alprazolam, fluticasone, meloxicam, tamulosin, tiotropium, and zolpidem. Initial vital signs including temperature were normal except for respiratory rate of 34 with pulse oximetry 99% on room air. He was oriented ×3 but confused, and physical exam was otherwise unremarkable. Abnormal labs included WBC 23.2, bicarbonate 15 mmol/L, AG 13, and creatinine 1.43 mg/dL. Salicylate and acetaminophen concentrations were not obtained. CXR showed a left lower lobe opacity. After blood cultures, antibiotics were begun and the critical care team planned lumbar puncture in the ICU. The patient became more obtunded and underwent ETI prior to ICU transport. Within 20 min of ETI, he became hyperthermic (39.1 °C) and hypotensive (63/40 mmHg). A fluid bolus produced transient improvement, but 45 min after ETI, the patient had a bradycardic arrest and could not be resuscitated. Salicylate concentration subsequently obtained from premortem blood was 112 mg/dL. Acetaminophen was undetectable and lamotrigine was subtherapeutic (1.5 mcg/mL).
Discussion: In cases of known salicylate toxicity, the risks of ETI due to decreasing serum pH and redistribution of salicylate to target tissues are well documented, but can be mitigated to some degree by hyperventilation, alkalinization, and early hemodialysis. With unrecognized salicylate toxicity, the risks are compounded as mitigation measures are unlikely to occur in a timely enough manner to be effective.
Conclusion: Serum salicylate should be considered prior to or at the time of ETI in patients with unexplained AMS, particularly in the setting of hyperventilation and/or increased anion gap.

057. Salicylate Toxicity After Undetectable Serum Salicylate Concentration: a Case-Control Study

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Background: Absorption of salicylates is usually rapid and quickly measurable in serum. However, a falsely reassuring undetectable serum salicylate concentration ([ASA]) may occur early after ingestion. Though cases of delayed salicylate detection are reported, the clinical factors associated with this phenomenon are not known.
Research Question: What factors are associated with an early undetectable [ASA] in salicylate poisoning?
Methods: Records from a single regional poison center were searched from 2002 to 2016 for cases of salicylate toxicity treated with bicarbonate and [ASA] > 30 mg/dL. The case definition was an initial [ASA] below that laboratory's lower limit of detection. Controls were records with detectable [ASA] recorded < 4 h post-

ingestion. Case information, serial [ASA], and outcomes were recorded and compared between groups.
Results: Three hundred thirteen records met all criteria with 11 cases and 302 controls. Time of first [ASA] occurred sooner in cases compared to controls (89 vs 137 min, $p = 0.011$ *t* test). Time to peak [ASA] was longer in cases (640 vs 321 min, $p < .001$). The longest interval between ingestion and undetectable [ASA] was 180 min. Peak [ASA] and reported mean ingested dose were similar in both groups (45 vs 50 mg/dL, p = NS; 19.7 g vs 32.9 g, p = NS, *t* test). Coingestion of agents that delay gastric emptying was similar in both groups (2/11 vs 76/302, p = NS, chi-square). Hemodialysis was performed in 1/11 cases and 17/302 controls (p = NS, chi-square). A single death occurred in the entire cohort in the control group.
Discussion: In this series, a small but significant proportion (3.5%) of patients had an initial undetectable [ASA]. Cases had [ASA] measured earlier after ingestion with a longer time to peak [ASA]. However, neither coingestion of agents prolonging gastric emptying nor reported dose ingested was different between groups. Formulation was infrequently recorded but one case did ingest a non-enteric coated product. Limitations include use of poison center data and partial data on coingestants and aspirin formulation.
Conclusion: [ASA] may be undetectable early after an overdose and serial measurements should be made to exclude toxicity with a history of salicylate ingestion.

058. The Plasma Half-Life of Ibuprofen Is Not Significantly Altered by Hemodialysis in the Setting of Ibuprofen Overdose—a Case Report.

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Background: Acute and chronic overdose of nonsteroidal anti-inflammatory drugs (NSAIDs) are associated with adverse effects on renal function including hyperkalemia, acute kidney injury (AKI) and metabolic acidosis. The plasma half-life of Ibuprofen is 1–3 h at therapeutic dosing. It has been postulated that rates of NSAID clearance would increase in overdose due to saturation of protein binding and increased availability of free drug. A previous study estimated elimination half-life of ibuprofen in overdose to be 0.86–3.06 h. No previous studies have evaluated the effect of hemodialysis on the elimination half-life of ibuprofen in overdose.
Methods: Single-patient chart review.
Case: A 28-year-old female with a history of congenital deafness was found down by EMS with a suicide note nearby. There were bottles of pills with the patient and her note stated that she had ingested 500 tabs of ibuprofen and 120 tabs of "Sleep PM." The patient was obtunded upon arrival to the emergency department and was intubated for failure to protect her airway. Her initial heart rate was 141 bpm, was normotensive, and normothermic. Her EKG showed sinus tachycardia with QRS 162 ms and QTc 573 ms. Initial labs showed normal renal function and a bicarbonate of 22 mEq/L. Her lactic acid quickly rose to 10.4 mmol/L with a serum pH 7.14 that was unresponsive to multiple boluses of sodium bicarbonate. Given her rapidly worsening acidosis, unresponsive to bicarbonate, the decision was made to initiate hemodialysis in the form of continuous renal replacement therapy (CRRT). A serum ibuprofen level just prior to initiating CRRT, 13 h after presentation, was 440 mcg/mL. A second level sent 9 h later just prior to stopping dialysis was 78 mcg/mL.
Discussion: In this overdosed patient, we calculated a plasma half-life of ibuprofen to be 3.6 h, which is similar to values previously reported for ibuprofen when taken in therapeutic doses and slightly longer than what was previously reported in overdose. This suggests that ibuprofen is not reliably cleared by CRRT.
Conclusion: The half-life of ibuprofen in a patient undergoing CRRT after overdose suggests that hemodialysis is not an effective means of clearing ibuprofen in the overdose setting.

Day 2: Platforms, Abstracts 059–062.

059. Factors Associated with Seizures in Bupropion Overdose: a 3-Year Review of the ToxIC Registry

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Background: Bupropion is a phenylethylamine antidepressant prescribed for depression, seasonal affective disorder, and smoking cessation. In overdose, it produces a variety of clinical effects, often consistent with sympathomimetic toxicity. Seizures occur in up to 30% of overdoses and may occur as late as 24 h post-ingestion of sustained- or extended-release formulations. It is currently not possible to predict which patients with bupropion overdose may have a seizure. We sought to determine what clinical signs and symptoms or demographics are associated with seizures in bupropion overdose. This is a pilot study to determine associations that may be used to formulate a predictive model.
Question: What clinical features are associated with seizures in bupropion overdose?
Methods: This is a retrospective review of the ToxIC database. It was queried from January 2014 to 2017 for cases with bupropion listed as a "primary agent" contributing to patient toxicity. Cases were excluded if the patients were < 13 years old or if there was at least one other primary agent.
Results: Seven hundred fifty-two cases were identified, with 260 cases remaining after exclusion criteria. Seizures occurred in 35.4% of cases, which is consistent with previous studies. A number of clinical features were found to be significantly associated with seizures: prolonged QTc (OR 3.29 CI 1.47–7.42), prolonged QRS (OR 7.3 CI 1.52–35.12), tachycardia (OR 1.69 CI 1.02–2.82), and hypotension (OR 16.43, CI 2.05–131.76). The following clinical features were not significantly associated with seizures: agitation (OR 0.89 CI 0.52–1.54), CNS depression (OR 1.73 CI 0.88–3.41), hyperreflexia (OR 0.98 CI 0.55–1.77), male sex (OR 1.0 CI 0.61–1.63). Sixty-two percent in both groups had a numerical QTc recorded. Average QTc was 482 ms in the seizure group vs 454 ms in the no-seizure group.
Conclusion: Seizures occur in 35% of bupropion overdoses and are associated with prolonged QT and QRS, tachycardia, and hypotension. Mean QTc was longer in the seizure group. Chronology of symptom onset and seizures is not possible with this dataset and requires future study. In our study, ECG findings and vital sign abnormalities were associated with seizures, suggesting that further study into these findings as predictors of seizures is warranted.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

060. The Virtual Toxicology Journal Club (#firesidetox): The Dissemination and Discussion of Noteworthy Manuscripts Using Twitter

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Background: In order to increase public outreach and promote medical toxicologists, the ACMT Public Affairs Committee (PAC) developed "firesidetox," an hour-long live, Twitter-based moderated chat to discuss noteworthy *Journal of Medical Toxicology* (JMT) manuscripts.
Hypothesis: Twitter-based interactive chat groups are feasible and expand engagement with manuscripts published in JMT.
Methods: A subcommittee of the PAC developed #firesidetox for a planned quarterly 1-h tweetchat. JMT manuscripts were selected by PAC and discussion topics were defined prior to each tweetchat. Members of PAC, editors of JMT, and at least one author were required to participate. Each tweetchat was advertised in advance by ACMT. Data were collected during the tweetchat hour and for 24 h following the event using a hashtag aggregator, Symplur. We calculated the number of unique views ("impressions"), identified participants through publicly available data on their twitter handles, and conducted a thematic analysis of tweetchats using two blinded assistants.
Results: Between January 2016 and November 2017, ACMT hosted four tweetchats attended by an average of 38 participants from the USA, Europe, the Middle East, and Australia. Twenty-six medical toxicologists participated in tweetchats. A mean of 155 tweets were generated during each tweetchat resulting in an average of 207,876 impressions. From the first tweetchat to the fourth, impressions grew by 48%, and the number of tweets increased by 30%. Most tweets centered around the theme of medical education (49%). Other tweets initiated potential research collaborations and described experiences from international participants related to featured tweetchat manuscripts.
Discussion: Tweetchats are a feasible method to engage the toxicology community and generate educational content related to JMT manuscripts. We were able to conduct successive tweetchats with increasing viewership (impressions) and attract toxicologists and international participants. Additionally, we were able to obtain an international perspective on featured manuscripts and provide expert toxicologist educational content to the general Twitter audience.
Conclusion: Hosting a quarterly tweetchat that connects medical toxicologists from around the world is feasible. Future work should examine the impact of outreach to the public by ACMT's tweetchat.

061. A Prospective Study of Factors Contributing to Scorpion Envenomation in Arizona

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Background: Arizona has the highest frequency of scorpion exposures reported to poison control centers (PCCs) in the USA, with 11,500 cases annually. The clinical effects of envenomation by *Centruroides sculpturatus* (Arizona bark scorpion) can be severe and require treatment with antivenom, especially at the extremes of age. Most cases (98.8%) are reported from a home/residential setting, but specific details are limited.
Research Question: To investigate factors surrounding scorpion envenomation in Arizona.
Methods: A questionnaire was designed to prospectively collect information about scorpion envenomation including victim demographics (age and body part stung), location of the scorpion (room and proximity to furniture/clothing), previous scorpion sightings and stings, and recent pesticide use. Staff from Arizona's two PCCs were asked to complete the survey for all home scorpion envenomation calls during a 4-week period in July and August 2017. Descriptive statistics and Pearson X^2 testing (with Bonferroni correction) were used for analysis.
Results: A total of 287 surveys were completed (30.8% response rate). Most victims were 20–69 years of age (64.5%). Exposures occurred predominately indoors (85.7%), with the most common sites in the bedroom (43.9%) and living room (19.1%). For stings in a bedroom, a bed/crib (58/108; 53.7%) was the most common location. In all other rooms, the floor was the most common (70/138; 50.7%). A significant association between age and room of sting was noted ($X^2 = 21.259$ (4), $P = 0.0003$), with residual analysis indicating children (< 20 years old) were stung more often in the living room compared to adults (36 vs. 13%, $P < 0.001$). Overall, the most common sting sites were the foot (35.0%), hand (21.0%), and leg (17.8%).
Discussion: Since beds were the most common scorpion location in bedrooms, efforts to prevent scorpion access to this furniture may be helpful. In other rooms, where the floor was the most common location, different strategies (such as wearing footwear) may be considered. Study limitations include the voluntary nature of reporting and a low survey response rate.
Conclusion: These findings can help inform public education, prevention efforts, and future research aimed at decreasing scorpion envenomation.

062. A Case Series of Patients with Massive Honeybee Envenomation

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Background: Massive honeybee envenomation may be life-threatening. Scientific literature regarding clinical effects of massive envenomation is mainly comprised of case reports, making it difficult to identify frequency of adverse effects and expected outcomes.
Research Question: What are the outcomes of patients admitted for massive honeybee envenomation?
Methods: Retrospective chart review of patients admitted to a single tertiary care center between January 1, 2006 and December 31, 2016 with diagnosis of massive honeybee envenomation. Identified by search of ICD 9 or 10 codes and review of toxicology logbook. Exclusion criteria included < 50 stings estimated. IRB approved. Charts were reviewed by two investigators and discrepancies were resolved with review by a third investigator. Data included demographics, clinical findings, laboratory values, and outcomes.
Results: 28 charts identified; 25 met inclusion criteria. Sixty percent were men; median age 60 years (55–71); 56% with baseline hypertension. Median length of stay (LOS) 39.25 h (20.25–80.25). Forty percent had estimated 50–100 stings, 48% 100–500 stings, 12% > 1000 stings. Findings included tachycardia (52%), hypertension (56%), facial edema (52%), extremity edema (40%), vomiting (43%), diarrhea (29%), and wheezing (20%). Five (20%) were intubated and two were hypotensive. Rhabdomyolysis (CPK > 100 U/L) developed in 44%, with median CPK 12,204 U/L (2,689–20,384). Eleven (44%) had elevated troponin (> 0.04 ng/mL), median 0.23 (0.12–1.25). Twenty-four percent developed acute kidney injury (Cr > 2.0 mg/dL) with median Cr 3.77 mg/dL (2.3–6.5). Treatment included anti-histamines (92%), steroids (92%), bronchodilators (44%), and vasopressors (16%). Epinephrine was given to 12/25 (48%); in 11/12 (92%) it was given pre-hospital or in ED only. Two patients underwent hemodialysis. There was one death.
Discussion: Massive honeybee envenomation risks venom toxicity rather than anaphylaxis; although acutely, patients often receive empiric anaphylaxis treatment. In this series, the majority of patients presented with hypertension and tachycardia with unclear need for epinephrine. Common outcomes included type 2 NSTEMI, rhabdomyolysis, AKI, and respiratory failure. The mean age and frequency of baseline HTN

suggests older patients with co-morbidities are vulnerable to severe toxicity.
Conclusion: Massive honeybee envenomation commonly causes morbidity including type 2 NSTEMI, rhabdomyolysis, respiratory distress, AKI, and death.

Day 2: Moderated Posters, 063–068

063. Emergency Department Discharge Prescribing in Association with a New Prescription Drug Monitoring Program

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Background: Prescription drug monitoring programs (PDMPs) are state-based tools that aid physicians in safely prescribing controlled substances via a web-based prescription database. In August 2016, Pennsylvania (PA) became the 49th state to implement a PDMP.
Hypothesis: We hypothesized that opioid prescribing from the emergency department (ED) following PA PDMP implementation would decrease for Schedule II drugs, and we sought to study the impact on frequently prescribed Schedule III/IV drugs as well as gabapentin.
Methods: A retrospective chart review of discharge prescriptions from two urban EDs in an academic medical institution was completed between August 2015 and August 2017. The time period was selected as 1 year prior and 1 year following implementation of the PA PDMP. The number of discharge prescriptions per month was collected for four medication groups: (1) Schedule II opioids (including hydrocodone, hydrocodone-acetaminophen (APAP), hydromorphone, oxycodone and oxycodone-APAP), (2) gabapentin, (3) APAP-codeine and (4) tramadol. To determine differences before and after PDMP implementation, regression and *t* tests were performed.
Results: Discharged from the two EDs during this time period were 181,920 patients. Provided at discharge were 7658 Schedule II opioid, 471 gabapentin, 1537 APAP-codeine and 1382 tramadol prescriptions. Results demonstrate a decrease in Schedule II–IV opioid prescriptions per patient discharged, without significant change in gabapentin prescribing. The mean percentage of patients discharged with a Schedule II prescription prior to PA PDMP implementation was 5.6 vs 2.7% following implementation ($p < 0.001$). A similar trend was noted for APAP-codeine (1.2% pre- vs 0.5% post-implementation, $p < 0.001$) and tramadol (0.9% pre- vs 0.7% post-implementation, $p = 0.002$).
Discussion: Results show fewer ED discharge prescriptions for Schedule II opioids, APAP-codeine and tramadol following PDMP implementation but no significant change in gabapentin prescriptions. Limitations include data collection at a single academic institution, parallel interventions with physician/patient education about safe opioid prescribing and gradual increased awareness of opioid limitations in conjunction with PDMP implementation. We did not study changes in rates of non-steroidal anti-inflammatory and APAP prescriptions.
Conclusion: The PDMP may contribute to a decrease in Schedule II opioid prescriptions as well as some Schedule III/IV opioid-related prescriptions from the ED.

064. Prevalence of Self-Reported Drug Allergies and Adverse Drug Events in an Urban, Academic Emergency Department

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Background: Current research on drug allergies and adverse drug events (ADEs) in the emergency department (ED) focuses on acute visits related to severe reactions. Knowledge of prior allergies and ADEs is paramount—missing documentation can lead to severe reactions, while over-reporting can lead to selection of inferior therapies.
Research Question: To determine the prevalence and nature of self-reported drug allergies and ADEs in an urban, academic ED.
Methods: This was a cross-sectional study, with a convenience sample of adult, English-speaking, clinically stable patients recruited over 6 months at an urban, academic ED with 90,000 annual visits. Age, sex, self-reported race, and number of daily medications were recorded. Patients listed prior drug allergies and non-allergic ADEs including the specific reaction experienced, if known. Frequencies and proportions were tabulated.
Results: Of 1014 patients recruited, the sample was predominantly black (81%), female (60%), and mostly in the 18- to 59-year-old range (69%). The majority were on ≥ 1 daily medication (74%). Three hundred fifteen patients (31%) reported at least one drug allergy. The most commonly implicated medications were antibiotics (200 patients, with penicillins [101] and sulfonamides [42] the most frequent), opioids (72 patients), iodine or intravenous contrast (41 patients), and non-steroidal anti-inflammatory drugs (NSAIDs) (31 patients). The most common allergic reaction described was hives (63–82%). Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers were exceptions, with 83% of reactions categorized as "swelling." Anaphylaxis was rare, with 10 cases reported across all drug categories. Two hundred fifty-two patients reported at least one ADE (25%), with opioids (85 patients), antibiotics (47 patients), and NSAIDs (38 patients) the most commonly cited. Specific reactions varied, but mirrored common ADEs to each class (nausea/vomiting for opioids, diarrhea for antibiotics, nausea, abdominal pain, and bleeding for NSAIDs).
Discussion: Drug allergies and ADEs were prevalent, with antibiotics, opioids, and NSAIDs commonly involved. Allergic reactions usually involved hives, with anaphylaxis rarely reported. ADEs mirrored known drug side-effect profiles.
Conclusions: Drug allergies and ADEs were prevalent in this study; further research is needed to determine optimal documentation platforms and if more accurate allergy and ADE documentation can improve medication selection and patient safety.

065. In Search of Acute Benzodiazepine Withdrawal: a Retrospective Review of an Academic Medical Center's Experience

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Background: Misuse of benzodiazepines (BZP) is common and there is concern that acute BZP withdrawal may result in morbidity or even mortality. However, there is paucity of medical literature regarding clinical characteristics and outcomes of acute benzodiazepine withdrawal. We sought to better characterize acute BZP withdrawal by examining cases managed at an academic medical center.
Hypothesis: Acute BZP withdrawal will be associated with significant morbidity and mortality.
Methods: This was a retrospective study. The EMR of a 600-bed academic medical center (annual ED census of ~ 50,000 patients, inpatient census ~ 30,000 patients) was queried for cases diagnosed with BZP withdrawal, drug withdrawal, sedative-hypnotic withdrawal or withdrawal-NOS from 1/1/2009 to 1/1/2016. Iatrogenic BZP withdrawal was excluded. Data collected included age, sex, month/year of encounter, type of drug withdrawal (alcohol, opioid, benzodiazepine or other), type of BZP withdrawing from, disposition, duration of hospital stay, presence

of seizures, need for endotracheal intubation, mortality and pharmacological treatment. Initially all authors abstracted the same 16 encounters and results reviewed to assure inter-rater agreement.
Results: A total of 357 cases were identified. After authors' evaluation, 82 cases were determined to involve BZP withdrawal with remaining cases being primarily opioid withdrawal ($n = 200$). The years with the highest number of BZP withdrawal cases were 2014 ($n = 14$) and 2015 ($n = 22$). In 31 (38%) cases there was a concurrent drug withdrawal. Opioid withdrawal ($n = 25$) was the most common other drug. Alprazolam ($n = 32$) was the most common BZP to be withdrawing from. Forty-one cases (50%) were admitted including 7 to the ICU. Seizures were reported in 8 (10%) cases. Endotracheal intubation occurred in 3 cases. Eighty-one percent ($n = 67$) of patients were treated with a BZP. Lorazepam ($n = 42$) was most commonly used. Phenobarbital and propofol were used in 2 cases, dexmedetomidine in 1 and no ketamine use was reported. There were no deaths. Upon discharge, 40 (49%) patients received a prescription for a BZP.
Conclusions: Acute BZP withdrawal was not common but did increase during the study period with occasional morbidity but no mortality. Further multi-center studies are warranted to better characterize the incidence and characteristics of acute BZP withdrawal.

066. Prevalence of Medication Allergy and Adverse Drug Event Reconciliation Discrepancies in an Urban, Academic Emergency Department

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Background: Medication reconciliation is a nationally recognized quality and safety measure; however, medication reconciliation in the emergency department (ED) is often inaccurate or incomplete.
Research Question: To characterize medication allergy and adverse drug event (ADE) discrepancies in the ED.
Methods: Cross-sectional study of a convenience sample of adult patients recruited at a single urban, academic ED. Study personnel asked patients to list any drug allergies and ADEs. Following the encounter, the patient's responses were compared to the electronic health record (EHR) to identify and characterize discrepancies.
Results: Of 1014 patients recruited, respondents were predominantly black (81%), female (60%), and aged 18–59 years (69%). Three hundred fifteen patients (31%) reported at least one drug allergy; the most commonly implicated medications were antibiotics, opioid analgesics, iodine/contrast agents, and non-steroidal anti-inflammatory drugs (NSAIDs). Two hundred fifty-two patients reported at least one ADE (25%), with opioids, antibiotics, and NSAIDs most commonly cited. Four hundred sixteen (41%) patients had a discrepancy between their self-report and the EHR. Discrepancies were more likely in middle-age adults and sub-octogenarians and amongst females. The most common type of discrepancy was missing allergies (172, 41.3%), followed by missing ADEs (169, 40.6%), allergies added by the EHR (91, 21.8%), allergies listed as ADEs or vice versa (59, 14.2%), and ADEs added (24, 5.8%). If an allergy or ADE was listed in the EHR, a full description was present in 18.4% of charts. Descriptions of the allergy or ADE were not complete for 21.8% of charts and absent in 59.8%. Fifty-seven (5.6%) patients were administered a medication they had had an allergy or intolerance to during their ED visit, but none of the EHRs were updated to reflect that.
Discussion: Missing documentation can lead to allergic reactions or ADEs, while over-reporting of a drug reaction as an allergy or ADE can lead to selection of suboptimal therapy. Further research should focus on improving documentation platforms as well as investigating adverse outcomes due to allergy and ADE reconciliation discrepancies.
Conclusion: In this ED study, drug allergies and ADEs were common and significant discrepancies existed in documentation of allergies and ADEs between the patient's self-report and the EHR.

067. Dexmedetomidine Use in the Critically Ill Poisoned Patient

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Background: Misuse of many xenobiotics can manifest with agitated delirium that requires chemical restraint and sedation. Dexmedetomidine use in the intensive care unit (ICU) has been associated with decreased delirium, ventilator time, and length of stay (LOS). However, there is limited data evaluating the effectiveness of dexmedetomidine on these parameters in the poisoned patient.
Research Question: Does dexmedetomidine improve LOS or ventilator time in the critically ill, agitated, poisoned patient?
Methods: We conducted a retrospective review from January 1, 2012 to December 31, 2016 of all cases of poisoning at our tertiary care, Level-1 Trauma Center that were admitted to the ICU for agitated delirium, required intubation with sedation, and received a Toxicology Consult. Exclusion criteria: age < 18 years, intubation not performed, opioid/sedative toxidrome. Descriptive analyses were carried out with *t* tests and chi-square tests used to analyze continuous and categorical variables, respectively.
Results: A total of 59 cases were analyzed. Thirty-two patients (54%) did not receive dexmedetomidine (No dex) and 27 (46%) did receive dexmedetomidine (dex) with or without other sedatives. Demographic distribution was similar between both groups. The average Poison Severity Score (2.7 vs 2.8, $p = 0.46$) and APACHE II score (11.9 vs 12.1, $p = 0.59$) were not significantly different for the two groups. The dex group had longer Total LOS (10.3 vs 6.3 days, $p = 0.03$), ICU LOS (7.4 vs 3.8 days, $p = 0.003$), intubation days (3.9 vs 2.7, $p = 0.03$), and days requiring other sedation (3.1 vs 2.3, $p = 0.06$). There was no statistically significant difference between rates of bradycardia or hypotension. The only death that occurred was in the No dex group.
Discussion: Limitations of this study include its retrospective nature and small sample size. Familiarity with prescribing dexmedetomidine likely changed over the study period. Unlike studies of all causes of ICU delirium, dexmedetomidine did not decrease intubation days or LOS in the critically ill poisoned patient.
Conclusion: In this study, dexmedetomidine was associated with longer ICU LOS and days on the ventilator. Due to study limitations, a prospective study is needed before the drug's utility in the poisoned, agitated patient can be determined.

068. A Prospective Observational Study of Prehospital Ketamine for Agitation Secondary to Cocaine or Methamphetamine Intoxication

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Background: Agitation from sympathomimetic intoxication in the prehospital environment may cause critical illness; rapid sedation is frequently required. The use of ketamine for such patients has increased, however, concern exists that ketamine's adrenergic properties may exacerbate sympathomimetic toxicity.
Hypothesis: Intramuscular ketamine (3–5 mg/kg) will result in rapid sedation of patients with agitation from sympathomimetic intoxication without significant increases in pulse or BP.

Methods: This was a prospective observational study of non-pregnant patients ≥ 18 years in our EMS system receiving ketamine sedation from August to November 2017 transported to our ED. Sympathomimetic intoxication was confirmed by history/exam and/or drug screen (immunoassay + G C/MS). Paramedics carried stopwatches and measured time to adequate sedation after injection, defined as a ≤ + 1 score on a validated agitation scale from − 4 (most sedate) to + 4 (most violent). Vital signs were recorded prehospital before and after ketamine, on ED arrival and 1 h post-ED-arrival.
Results: Thirty patients were enrolled (cocaine, $n = 10$; methamphetamine, $n = 19$; both, $n = 1$). Twenty drug screens were obtained; all were positive (cocaine, $n = 9$; methamphetamine, $n = 12$). Median age was 33.5 years (range, 19–58); 76.7% were male. Median time to adequate sedation was 5.5 min (95% CI 3.7–13.0; range, 1.2–32.8) with 76.7% adequately sedated prehospital. Eight patients (27.6%) received additional sedation prehospital. Seventeen patients were too violent to safely obtain vital signs before ketamine administration. Median pulse and BP were as follows: pre-ketamine 133 bpm ($n = 12$; range 82–190), 162/87 mmHg ($n = 7$; range 103/68–218/110), prehospital post-ketamine 132 bpm ($n = 27$; range 85–172), 148/87 mmHg ($n = 27$; range 92/54–200/138), on ED arrival 131 bpm ($n = 30$; range 84–179), 144/92 mmHg ($n = 30$; range 83/43–207/158), and 1-h post-ED-arrival 100 bpm ($n = 30$; range 80–132), 122/76 mmHg ($n = 30$; range 88/32–163/115). No statistically significant difference in vital signs was found between the first three time points (p = NS, Kruskal-Wallis H test); 1-h post-ED vital signs were significantly lower ($p < 0.0015$).
Discussion: In these data ketamine provided effective, safe sedation for sympathomimetic intoxication. Larger, controlled studies are needed to confirm these findings.
Conclusion: Ketamine for prehospital agitation secondary to sympathomimetic intoxication resulted in rapid sedation without significant increases in pulse or BP; pulse and BP were significantly lower at 1 h.

Day 2: Posters, 069–118

069. A Critical Assessment of Toxicology Content on FOAM

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Background: Free Open Access Medical Education (FOAM) sites are popular educational adjuncts for Emergency Medicine physicians. Peer review in FOAM is not robust or mandatory, which could allow for factual errors or overstated clinical recommendations. We sought to determine the factual accuracy of content and appropriateness of clinical recommendations in toxicology FOAM posts.
Hypothesis: We hypothesize the accuracy of FOAM toxicology posts is low and that translating information from these posts to clinical practice may cause harm.
Methods: This is a retrospective analysis of toxicology FOAM posts. The top 50 popular FOAM sites were identified using the SMi-50 and toxicology content was identified using keywords (toxicology, poisoning, toxicity, envenomation, overdose, withdrawal). On review, non-toxicology posts were excluded. Two medical toxicologists reviewed de-identified posts using a modified version of a previously validated tool to assess accuracy, educational value, use of evidence-based medicine and references. A global score ≥ 24 or individual category score ≥ 6 defined a high-quality post, consistent with previous utilization of the validated tool. Posts were determined to contain potentially misleading or harmful clinical recommendations based on reviewer assessment. t tests and chi-squared statistical analysis were used.
Results: Of 85 posts reviewed, 75 were included. Average global score was 19.8 (CI 18.7–20.1), accuracy score was 5.0 (CI 4.6–5.5) and evidence score was 3.7 (CI 3.3–4.0). Twenty-nine posts (38.7%) contained significant inaccuracies. Medical toxicologists authored/edited 9 (12%) posts. Posts by medical toxicologists had significantly higher global (23.1 [CI 21.4–24.7] vs 19.3 [CI 18.1–20.6]; $p = 0.03$), accuracy (6.6 [CI 6.0–7.1] vs 4.8 [CI 4.4–5.3]; $p = 0.01$), and evidence scores (5.0 [3.9–6.1] vs 3.4 [3.1–3.9]; $p = 0.01$), and were less likely to contain misleading/harmful clinical recommendations (0% vs 42.4%) compared to those by non-medical toxicologists. Kappa 0.5–0.7.
Discussion: FOAM toxicology posts had low global scores, and frequently contained inaccuracies and misleading/harmful clinical information. Although the absolute number was small, inaccuracies and misleading recommendations were less common in medical toxicologist authored posts.
Conclusion: Toxicology FOAM resources are of low quality. Quality is improved when medical toxicologists participate. FOAM content may benefit from increased involvement from medical toxicologists.

070. Characterization of Toxic Sites in Low- and Middle-Income Countries (LMICs); Need for Improved Medical Surveillance

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Background: Toxic sites alone represent a health risk to more than 80 million people in LMICs. An intense effort to catalog toxic sites internationally has spanned the last decade.
Research Question: How are toxic sites characterized in terms of volume, exposure characteristics, and health outcomes?
Methods: This literature review screened PubMed database using search terms (LMIC, toxic site, mortality, morbidity, health effect, or outcome) and included reports from governmental and nongovernmental organizations (NGOs) while excluding case reports, commentaries/letters, publications > 10 years old, and non-English articles. Data reviewed included agency, site volume, toxin, decontamination status, source, region, age group, medical surveillance, and health outcomes.
Results: Two hundred forty-one articles were identified, including 166 reports [111 Pure Earth/Global Alliance on Health and Pollution (GAHP), 34 World Bank, 11 World Health Organization, 5 United Nations, and 5 Médecins Sans Frontières]. The Pure Earth Toxic Sites Identification Program (TSIP) is a leading program identifying and decontaminating sites, partnering with governmental and NGOs to form the GAHP. As of October 2017, Pure Earth identified 4318 sites, conducted risk assessments at 2956, and completed 84 site decontaminations with 12 in progress. World Bank has sponsored more than 300 decontaminations. Lead (1241, 29%), mercury (517, 12%), arsenic (416, 10%), and chromium (349, 8%) were the major contaminants of the identified TSIP sites. Other contaminants include pesticides, cadmium, and organic chemicals. In previous studies, due partly to limited epidemiological evidence, chromium VI and lead accounted for more than 99% of attributable disability-adjusted life years (DALYs). Lead battery recycling is the main industrial source. Low-income countries and children (< 5 years old) are disproportionately affected. No standardized medical surveillance system recording specific health outcomes was identified.
Discussion: Longitudinal data regarding health effects, disease severity, and treatment is lacking. Creating medical surveillance, such as a hospital and clinic-based registries, could better identify injuries and assist in harm reduction. Medical toxicologists in partnership with local clinicians, governmental, and NGOs could develop surveillance systems, and improve health outcomes and international collaboration.
Conclusion: Although there is growing data on the identification and exposure sources of toxic sites, there is limited data assessing health outcomes.

071. Poison Center Calls Made from the Time Hurricane Harvey Made Landfall Up to 2 Weeks

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Background: A record 51.88 in. of rainfall was measured during Hurricane Harvey. Previous studies related to hurricanes focused on carbon monoxide and hydrocarbon exposure. Limited data exist on poison center calls that are labeled specifically for a public health event.
Hypothesis: To characterize the calls to Texas poison centers that were identified as public health emergencies after a hurricane that caused record flooding in Harris county.
Methods: All hurricane-related calls from Harris county during August 25th–September 7th were collected. The code used to identify hurricane-related calls was '**___PHEMERG/Event**'. Toxic exposures and outcomes were categorized. The study has IRB approval from the Texas Department of State Health Services.
Results: A total of 111 calls were made, 16 of which requested information and 95 reported exposure. The 95 exposure calls reported a total of 152 substances, with some calls reporting exposure to more than one agent. These 152 agents consisted of 14 different medications, 23 different chemicals, and four envenomations (three snakebites and one spider bite). Calls were equally split between males and females. Seventy of the 95 calls reported exposure to a single substance. Most exposures were in homes (63, 66%) and 54 callers (60%) were referred to health care facilities. There was an occupational exposure to organic peroxides on August 31 (20 males and 1 female). Nineteen of the 21 exposed had symptoms including cough, shortness of breath, headache, and sore throat. All 21 cases were evaluated and most were treated with bronchodilators before being discharged from the hospital. There was a fire at a manufacturing plant on September 3, which resulted in 12 calls from residences in the area. This fire resulted in an exposure to organic peroxide and dimethyl and tertbutyl hydroperoxide. All 12 cases reported dizziness and headache. All 12 were evaluated, treated, and released from a hospital. There were three calls regarding snakebites; all occurred in flooded residences. No species identified.
Conclusion: Two events resulted in more than one third of hurricane event-related calls. Snakebites are an unrecognized event after flooding related to hurricanes.

072. American College of Medical Toxicology Longitudinal Survey of Medical Toxicologists

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Background: The American College of Medical Toxicology (ACMT) Longitudinal Study of Medical Toxicologists aims to describe changes in the practice of medical toxicology over time and the relationship of the specialty to the personal lives and well-being of medical toxicologists.
Research Question: What were the baseline characteristics of respondents in the ACMT Longitudinal Study of Medical Toxicologists and what were respondent's attitudes and perceptions of medical toxicology?
Methods: In 2015, medical toxicologists who were ACMT members and became board certified in 1994, 2004, and 2014 participated in a stratified survey. The survey and study were approved by the ACMT research committee. The survey consisted of five sections: (A) professional interests, attitudes, and goals; (B) training and certification; (C) professional experience; (D) well-being and leisure activities. Baseline results were analyzed using descriptive statistics.
Results: The overall response rate for all three cohorts was 47/83 (57%). Two thirds of respondents were men. All respondents were actively working and 79% of respondents currently worked in medical toxicology. Seventy-two percent trained primarily in Emergency Medicine and the remainder trained in pediatrics, internal medicine, occupational medicine, psychiatry, or pediatric critical care. Most medical toxicology practices were based out of urban teaching hospitals (43%), university hospitals (36%), and/or poison centers (36%). Most (87%) had published at least one article in the last 5 years and 40% of respondents were supported by research grant/contract funding. On a 6-point Likert scale, the average happiness rating of respondents was 4.5. In leisure time, 83% regularly exercised and majority of respondents chose to spend time with family (82%), spend time with friends (68%), and/or travel (68%).
Discussion: This was the initial experience in surveying medical toxicologists' work environment, career perspectives, and personal well-being. Of those responding, most continued to practice medical toxicology, were academically productive, and reported high rates of happiness. Although response rate was adequate, results might have been skewed by selection bias of those who chose to answer the survey.
Conclusion: The initial results of the ACMT Longitudinal Survey of Medical Toxicologists showed active participation in medical toxicology and positive attitudes towards work and life.

073. Career Satisfaction in Medical Toxicology: Analysis of the 2015 American College of Medical Toxicology Longitudinal Study of Medical Toxicologists

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Background: There is little reported about job satisfaction among medical toxicologists. In 2015, the American College of Medical Toxicology (ACMT) invited members who first became board-certified in 1994, 2004, and 2014 to participate in a longitudinal study for medical toxicology.
Research question: What is career satisfaction among medical toxicologists participating in the 2015 ACMT Longitudinal Study of Medical Toxicologists?
Methods: This is a survey-based study created with voluntary sampling of medical toxicologists who first became board certified in 1994, 2004, and 2014. The survey and study were approved by the ACMT research committee. Using similar methodology employed by the American Board of Emergency Medicine Longitudinal Study of Emergency Physicians, the survey contained 103 questions about professional interests, attitudes, and goals; training and certification; professional experience; and well-being and leisure activities. Results from career satisfaction questions were analyzed using descriptive statistics.
Results: The ACMT longitudinal survey had a response rate of 57% (47/83). Medical toxicologists report high job satisfaction with an average score of 3.9 on a 5-point Likert scale (1 = not satisfied, 3 = satisfied, 5 = very satisfied). They also report that their current work is fun with an average score of 3.9 on a 5-point Likert scale (1 = almost never fun, 3 = sometimes fun, 5 = almost always fun). Seventy-nine percent of respondents felt that his/her career has "met" or "exceeded" expectations. A majority of respondents "definitely would choose medical toxicology" (56%) or "probably would select medical toxicology" (32.5%). Only 5% are "currently seriously thinking of leaving clinical medical toxicology," while 26% have "ever seriously considered leaving."
Discussion: A majority of survey respondents consider medical toxicology to be a satisfying and fun career. While some have considered leaving the field, very few are seriously considering leaving. There may be bias since this is a self-selected sample who may not represent all medical toxicologists. Those who are currently doing little to no toxicology may not have responded to the survey.
Conclusion: Medical toxicology is a fun and satisfying subspecialty among survey respondents in the 2015 ACMT Longitudinal Survey.

074. Pancreatitis in a Case of Systemic Loxoscelism

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Background: Systemic loxoscelism is typically manifested by a systemic inflammatory response, hemolysis, rhabdomyolysis, DIC, acute kidney injury, and rarely, death. However, pancreatitis has not previously been associated with systemic loxoscelism.
Hypothesis: Pancreatitis may occur as a part of systemic loxoscelism.
Methods: Single-patient chart review.
Case: A 5-year-old female with no past medical history, medications, or contributing family history presented to the hospital with a fever of 39.3 C, headache, nausea, vomiting, diarrhea, dark-colored urine, jaundice, and left-sided flank pain with a rapidly progressing left-sided flank lesion. The lesion looked like a small insect bite1 day prior to arrival, and upon arrival, her left flank was covered with scattered ecchymotic lesions with an associated 12 × 18 × 2 cm fluid collection per CT. She had hemolytic anemia with a hemoglobin drop to 5.5 g/dL on hospital day 3 (drop of 5.7 units from presenting level). Her blood, wound, respiratory viral, and throat cultures were negative. She developed central wound necrosis with black eschar formation by hospital day 5 and was discharged on hospital day 14. While a spider had not been identified, the clinical presentation was thought to be most consistent with systemic loxoscelism. Our patient presented with an initial lipase of 1214 units/L, nausea, vomiting, and left flank pain. Her abdominal ultrasound revealed pancreatic edema without peripancreatic fluid collections and a normal gallbladder with normal biliary tract. Triglycerides were 132 mg/dL. Her lipase peaked on hospital day two (2381 units/L) and normalized by hospital day 6.
Discussion: Hemolytic anemia is a well-known complication of systemic loxoscelism. There is evidence that 20% of patients who develop massive hemolysis from other conditions will develop pancreatitis. None of the most common pancreatitis etiologies were present. Lipase elevation can be seen in diabetic ketoacidosis, renal failure, severe burns, trauma, and multi-organ failure, which were not present. A proposed mechanism for pancreatitis associated with hemolytic anemia is pro-inflammatory release triggered by free heme.
Conclusion: Pancreatitis may be associated with systemic loxoscelism in which massive hemolysis occurs.

075. Successful Treatment of Brown Widow Spider Envenomation with *Latrodectus mactans* Antivenom

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Background: Brown widow (*Latrodectus geometricus*) spiders are becoming increasingly common in the USA; it has been suggested that they may be displacing black widow spiders by competing or fighting for territory. An antivenom for black widow (*Latrodectus mactans*) spiders is available, but there are minimal data on its efficacy in the treatment of *L. geometricus* envenomations.
Hypothesis: *L. mactans* antivenom can effectively manage the symptoms of brown widow spider envenomation.
Methods: Single-patient chart review.
Case: A 54-year-old female presented to the emergency department (ED) after sustaining a spider bite to her right lateral chest wall. She killed the spider and brought it with her to the ED, where it was positively identified by a medical toxicologist as a brown widow. The patient initially complained of severe 10/10 right lateral chest and axillary pain, with associated chills and nausea. Physical examination demonstrated a 1-cm area of erythema to the right lateral chest wall but was otherwise unremarkable. She was treated with intravenous morphine without significant improvement in her symptoms. Subsequently she was administered one vial of *L. mactans* antivenom intravenously over 30 min. Sixty minutes after the infusion was started, the patient was symptom-free. She was observed for an additional hour without demonstration of any adverse effects and was discharged home shortly thereafter.
Discussion: We report the successful treatment of a brown widow spider envenomation with *L. mactans* antivenom. Previous studies have demonstrated that the primary active venom component, a-latrotoxin, shows > 94% nucleotide homogeneity across *Latrodectus* species. This suggests that *L. mactans* antivenom should have significant cross-reactivity with *L. geometricus* venom and its use should be considered in symptomatic envenomations from brown widow spiders.
Conclusion: The symptoms associated with brown widow spider envenomation can successfully be managed with the administration of *Lactrodectus mactans* antivenom.

076. Systemic Toxicity after New World Tarantula Envenomation

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Background: Tarantulas (*Theraphosidae*) are historically considered to be non- or minimally venomous. More recently, however, there have been reports of systemic toxicity from tarantulas of the genus *Poecilotheria* that are endemic to India and Sri Lanka (Old World tarantulas). We report a case of envenomation by a New World tarantula species causing delayed severe muscle cramping and pain.
Hypothesis: New World tarantula envenomation can cause systemic symptoms.
Methods: Single-patient chart review of systemic muscle spasms following a bite by a New World tarantula (likely *Megaphobema* as confirmed by an entomologist).
Case: A 56-year-old exotic pet trader was handling a tarantula when she was bit on the right fifth finger. She felt immediate pain and developed bleeding at the bite site with swelling of her hand. Approximately 9 h later, she awoke from sleep with severe back spasms and upon getting out of bed also developed arm and leg spasms. These spasms were worse with ambulation and movement. She was admitted to the hospital for symptom control and was treated with opiates and benzodiazepines that provided some relief. Her creatine kinase was mildly elevated with a peak of 309 mg/dL. Her creatinine and electrolytes, including calcium and magnesium, remained within normal ranges on serial measurement. Pain and swelling at the bite site resolved within 1 day. Muscle spasms morphed into generalized muscle soreness during her hospital stay. She was discharged home in stable condition after 3 days.
Discussion: This is to our knowledge the first case report of systemic envenomation by a New World tarantula species. In vitro studies have shown tarantula venoms can inhibit calcium, potassium, and sodium channels depending on the species and specific venom components. One or a combination of these is likely the cause of the muscle spasms observed clinically. It is unclear whether this effect is mediated at the spinal cord, peripheral nerve, or the muscle level.
Conclusion: New World tarantula envenomation appears capable of causing systemic toxicity despite the widespread consensus that their bites are harmless.

077. Rattlesnake Envenomations Treated Without Antivenom

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Background: Outcomes of rattlesnake envenomations (RSEs) treated without antivenom are unstudied.
Research Question: What are outcomes of moderate to severe RSEs treated without antivenom?

Methods: Retrospective series of RSEs at Banner-University Medical Center from 1991 to 2015 treated without antivenom, and having peak Snakebite Severity Score (SSS) ≥ 4. Data included demographics, clinical, and laboratory parameters. SSS 4–6 was considered moderate and ≥ 7 severe. Severe RSEs are further described.
Results: 17 cases comprised 14 moderate and 3 severe envenomations. 82% men; 65% lower extremity bites. Reasons for withholding antivenom: unfavorable risk/benefit ratio in 11/17; not documented 4/17; patient refusal 2/17. Risks included prior antivenom ± hypersensitivity reaction, beta blocker use, and medical co-morbidities. Three severe RSEs (peak SSS = 8) are described: (1) 33-year-old F, foot bite, presented with swelling to knee, platelets = 140 K/mm^3, fibrinogen = 226 mg/dL, and Hgb = 13.7 g/dL. SSS = 3. On day 2 platelets = 88 K/mm^3, fibrinogen<15 mg/dL. Swelling progressed to the entire extremity and abdomen; hemoglobin = 6.6 g/dL by day 4. CT abd/pelvis without bleeding. Two units PRBCS given; length of stay (LOS) = 5 days. (2) 22-year-old M, wrist bite, presented with swelling to elbow, platelets = 238 K/mm^3, PT = 14.2 s, hemoglobin = 16.4 g/dL. SSS = 3. Day 2 hemoglobin rose to 21.8 g/dL due to venom-induced fluid extravasation; swelling progressed over 6 days to the entire arm, trunk, scrotum, and upper legs. By day 4, fibrinogen = 102 mg/dL, platelets = 8 K/mm^3. Hemoglobin nadir = 8.5 g/dL. CT abd/pelvis without bleeding. LOS = 7 days. (3) 49-year-old M, hand bite, presented with swelling to axilla, platelets = 157 K/mm^3, fibrinogen = 214 mg/dL, and hemoglobin = 14.9 g/dL. SSS = 4. Swelling progressed over 4 days to the left chest and thigh; platelets = 45 K/mm^3 and fibrinogen = 391 mg/dL on day 3. Hemoglobin nadir 8.0 g/dL day 6. LOS = 8 days. Platelet nadir occurred between 32 and 59 h in severe cases.
Discussion: Prior to 2000, an immunogenic antivenom was used, but was sometimes withheld after risk/benefit assessment. Today, safer antivenom is standard and even mild RSEs are typically treated. In this study 18% experienced progressive morbidity (worsening SSS and thrombocytopenia, soft-tissue bleeding, prolonged LOS).
Conclusion: Severe RSEs presented as mild to moderate. Swelling, hematotoxicity and bleeding can worsen for days without antivenom.

078. 17 Bites, 17 Antivenins, 1 Allergic Reaction

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Background: Persons who experience repeated snake envenomation are believed to be at higher risks of hypersensitivity reactions to antivenins that are administered as treatment.
Hypothesis: Repeated administration of antivenins may cause harm to the patient.
Methods: This is a single-patient case series. Data was collected retrospectively from hospital visits from April 2010 until September 2017.
Results: Over the course of 7 years, a 59-year-old man with history of repeat snake envenomation presented multiple times to the Emergency Department (ED) after being bitten by various exotic, venomous snakes. Variables collected include snake species, bite location, ventilator requirements, and coagulation parameters (INR, aPTT, platelet count, and fibrinogen level). The patient experienced multiple envenomation episodes requiring hospitalization. The species of snakes included *Crotalus scutulatus*, *Bothrops asper*, *Naja naja, Crotalus basiliscus*, *Crotalus terrificus*, and *Naja mossambica*. The patient required mechanical ventilation following envenomation from the *Naja naja* and *Crotalus terrificus*. Additionally, the patient experienced significant coagulopathy following *Bothrops asper* envenomation with fibrinogen level of 35 mg/dL, platelet count of 161,000/μL, and INR of 1.7. Following envenomation by the *Naja mossambica*, the patient developed an allergic reaction to the targeted antivenin. However, reaction responded to the administration of corticosteroids, famotidine, and diphenhydramine; antivenin treatment was continued without further reaction.
Discussion: Each species of venomous snake has characteristic toxicities of which requires supportive care as well as targeted antivenin to assist in clearing venom toxins. Serious adverse events can arise at varying times following snake envenomation. Antivenin-induced hypersensitivity reactions can occur following the administration of antivenin and include anaphylaxis and serum sickness. The risk of these reactions is thought to increase with subsequent administrations. Advances in antivenin manufacturing have diminished the frequency of anaphylaxis; the potential for antivenin-induced hypersensitivity remains a possibility nonetheless. Although this case series demonstrates the successful outcomes following repeat snake envenomation, it is still unclear to what extent repeat envenomation increases the risk of anaphylaxis to snake venom proteins or antivenin antibodies.
Conclusion: This case series demonstrates the successful treatment of a patient who experienced repeat envenomations treated with antivenin without deleterious outcome.

079. Healthcare Charges Incurred from Scorpion Envenomation Treated with *Centruroides* F(ab')$_2$ Antivenom

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Background: *Centruroides* F(ab')$_2$ antivenom (AV) is a safe and effective treatment for bark scorpion envenomation; however, concern exists regarding the substantial costs of this therapy. This retrospective review seeks to quantitate patient charges associated with AV use to better understand its impact on patient and healthcare economics.
Methods: This is a retrospective review of 200 random patients presenting to a hospital system with severe scorpion envenomation between April 2013 and May 2015. Included patients had *Centruroides* scorpion envenomation and received AV. They were excluded if clinical records were not available. Patient charges and hospital costs were acquired from institutional financial records. Clinical manifestations, length of stay (LOS), method, and amount of AV administration were abstracted. Continuous data were reported as median with interquartile range, and linear regression was utilized to determine predictors of outcomes.
Results: All patients had a grade 3 or 4 envenomation and received AV. Most patients were treated in the ED (95.5%) with few requiring admission (1.5%) or observation (3.0%). The total number of vials received were three vials (40.5%), one vial (23.0%), two vials (20.5%), four vials (11.5%), five vials (4.0%), and six vials (0.5%). Most patients received one vial of AV initially (53.5%) compared to two (5.0%) or three (41.5%). Median total charges (IQR) was $27,524.00 ($18,694.75–$32,681.00). Linear regression showed that total charges were predicted by total number of vials administered and LOS (adjusted R^2 of 0.75). Each additional vial increased the total charges by $8091.98 and each additional hour increased charges by $327.51. Correlation between total charges and costs was poor.
Discussion: In this study, the total number of AV vials was the strongest predictor of total charges. This may explain why healthcare providers elected to administer one vial initially, although the package insert recommends three. Despite this approach, most patients required ≥ 3 vials

total. It appears that anticipated patient charges impacted the method by which providers utilized this expensive treatment.
Conclusion: Despite established safety and efficacy, anticipated patient charges appear to influence the manner in which bark scorpion antivenom is administered by healthcare providers.

080. A Multidisciplinary Exotic Venomous Snakebite Drill

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Background: Zoos housing non-native venomous snakes typically import antivenom from countries of origin with FDA permission to have available in the event of employee envenomation. Because exotic snakebite is uncommon, medical providers may be unfamiliar with clinical presentation and treatment.
Hypothesis: An exotic snakebite drill involving EMS, the zoo, ED, and poison center (PC) can identify potential procedural problems before an actual envenomation event occurs.
Methods: A large metropolitan zoo currently stocks three imported polyvalent antivenoms: CSL (Australia), SAIMR (South Africa), and Antivipmyn (Mexico), each in sufficient quantity to treat one severe envenomation. The zoo also maintains expired antivenom, including some monovalent products (which it no longer purchases), in the event of multiple bites. On the day of the drill, a zoo employee played the role of a *Pseudechis australis* (king brown) snakebite victim. EMS was called to transport the victim, with the species-specific PC-written protocol and (expired) antivenom to the ED where she was evaluated. The PC was contacted and bedside toxicology consult was requested. Pharmacist preparation of antivenom was included in the drill, though it was not actually administered. Throughout the process a checklist was completed and timeline recorded.
Results: At the zoo, all predetermined steps, from securing the snake to notification of EMS, PC, ED, first aid application, and victim transport to ED with appropriate PC-written protocol and antivenom were performed in a timely fashion. The victim was seen by the ED provider, and, after bedside toxicology consult, antivenom was ordered. However, discrepancies were noted between antivenom administration instructions accompanying the drug and written protocols with regard to both dosage units and administration time, resulting in a delay of 15 min for clarification.
Discussion: Discrepancies in antivenom administration instructions could potentially lead to confusion and treatment delays in an actual envenomation event. A contributing source of error was the use of expired monovalent antivenom in this exercise instead of CSL polyvalent, our standard recommendation for clinically significant Australian snakebite.
Conclusion: For events such as exotic envenomations that may require rarely used antivenoms, multidisciplinary drills can uncover and prevent unanticipated procedural problems.

081. US Poison Center Recommendations for ECG Monitoring in Pediatric Exploratory Ingestions

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Background: Poison centers (PCs) are frequently called about pediatric exploratory ingestions (PEI) with the potential for QT prolongation. The incidence of dysrhythmia following PEI appears to be low and the optimal approach to ECG monitoring remains unclear.
Research Question: Do PCs have a consistent approach to ECG monitoring following suspected PEI?
Methods: Using the American Association of Poison Centers' listserv ($n = 259$), an electronic survey link was sent to managing/medical/associate directors and consulting toxicologists at 55 US PCs. The survey asked about their recommendations for ECG monitoring in children with exploratory ingestion of QT-prolonging agents from several drug categories and factors that might influence respondents' recommendations.
Results: We received 39 survey responses from 31 PCs, yielding a response rate of 15.1% for individuals and 56.3% for PCs. Most respondents (56.4%) indicated that their PCs do not have a general guideline for recommending ECGs in children ≤ 6 years old with suspected ingestion. When asked about minimally symptomatic children with suspected ingestion involving specific drug classes, 100% indicated that they would recommend an ECG for cases involving cyclic antidepressants (CAs), followed by antidysrhythmics (97.4%), neuroleptics (68.4%), SSRIs (63.2%), and antihistamines (47.4%). Within each drug class, respondents were more likely to recommend ECGs for specific agents, such as citalopram for SSRIs and quetiapine for neuroleptics. Respondents indicated that the factors most likely to prompt recommendations for a repeat ECG were progressive vital sign or neuromuscular abnormalities (97.4%) and initial QTc above a specific threshold (73.7%). The QTc threshold values provided by respondents ranged from 440 to 550 ms (median 500).
Discussion: Survey results suggest that PC recommendations for ECG monitoring in PEI are based on a combination of case-specific factors and the drug involved, with most respondents recommending ECGs for cases involving CAs, antidysrhythmics, and selected other agents. Most respondents would follow the QTc above a certain threshold, but the cutoff was variable. The study was limited by low survey response rate.
Conclusion: Most PCs recommend ECG monitoring in PEI involving CAs, antidysrhythmics, and other QT-prolonging drugs, but individual recommendations are tailored to case specifics.

082. ECG Changes Due to Severe Hypermagnesemia

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Background: Magnesium is the fourth most common cation in the human body and the second most abundant intracellular electrolyte. Hypermagnesemia is rare in the absence of renal failure but, when present, predicts an increase in all-cause mortality.
Methods: This is a single-patient chart review of a 24-year-old female with cerebral palsy and tracheostomy dependence.
Case: The patient was admitted to the hospital for ventilator-acquired pneumonia and started on cefepime. After admission labs, no labs were checked for 2 weeks. On hospital day 18, she became less responsive, hypotensive, tachycardic, hypothermic, and acidemic. Laboratory evaluation showed an elevated creatinine of 2.0 mg/dL (three times her baseline), mild hypercalcemia (10.8 mg/L), hypokalemia (2.6 mEq/L), and severe hypermagnesemia (reported as > 24 mg/L). She had no baseline magnesium upon admission, but her magnesium during her prior admission was normal. An ECG was performed and demonstrated an irregularly irregular rhythm without obviously discernable p waves before all QRS complexes, similar in appearance to coarse atrial fibrillation. Iatrogenic magnesium intoxication was suspected; however, the source of the exposure could not be elucidated despite a detailed medication history, review of all hospital-administered medications, and pharmacy audit to rule out a dosing or TPN formulation error. Due to her renal failure and unknown source of the magnesium, continuous renal replacement therapy (CRRT) was initiated. Upon completion of CRRT, the patient's magnesium decreased to 2.3 mg/dL. A repeat ECG showed a return to her baseline normal sinus rhythm.
Discussion: Magnesium acts as a natural calcium channel blocker. Hypermagnesemia can affect the central nervous and cardiovascular

systems through changes in resting membrane potential, suppression of the sino-atrio node, inhibition of calcium influx through sarcolemmal channels, sympathetic nervous system blockade, and inhibition of myocyte potassium efflux. ECG findings associated with hypermagnesemia include bradycardia, first-degree AV block, junctional rhythm, sinus arrest, prolonged QRS interval, prolong QT segment, new left bundle branch block, and asystole.
Conclusion: In addition to the above electrocardiographic changes, hypermagnesemia has the potential to cause an electrocardiographic tracing similar in appearance to coarse atrial fibrillation.

083. Prolonged QT Interval Associated with Overdose on Pyrilamine-Containing Products

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Background: Pyrilamine is an H1 antagonist medication included in some over-the-counter preparations, especially those used for menstrual cramps. It has some anticholinergic effects, but its effects on the QT interval are not well described.
Research Question: Are patients exposed to pyrilamine at increased risk for prolonged QT interval?
Methods: A retrospective review of cases reported to our regional poison center from January 2002 until March 2016 which was coded as exposures to a pyrilamine containing product. Data abstracted included demographics, dose of pyrilamine, other substances reportedly ingested, initial QTc, longest QTc, and serum electrolytes. Descriptive statistics were calculated as appropriate.
Results: One hundred eighty-seven cases were identified, of which 28 had a QTc documented, one of these patients was male. Fourteen cases had a QTc greater than normal limits, five were > 500 ms, and the mean QTc was 473 ms. Only one of the patients with a prolonged QTc had a reported coingestion of a QTc-prolonging drug. Seven of the patients with a prolonged QTc had notable hypokalemia, including four of the cases with QTc > 500 ms.
Discussion: This series demonstrates that pyrilamine overdose can be associated with prolonged QTc in the absence of other identified causes. The most severe cases were typically associated with hypokalemia, probably related to caffeine coingestion. This study is limited by a large fraction of initially identified cases without a QTc documented.
Conclusion: Pyrilamine overdose can be associated with prolonged QTc, augmented by hypokalemia from caffeine overdose.

084. Drug-Specific Risk of Severe QT Prolongation Following Acute Drug Overdose

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Background: Severe QT prolongation (SQTP) has been identified as a strong predictor of adverse cardiovascular events in acute drug overdose.
Research Question: What are the drug-specific causes of SQTP in the setting of acute drug *overdose?*
Methods: This was a prospective cohort study at > 50 hospital sites across the USA using the ToxIC Registry between 2015 and 17. Inclusion criteria were adults (≥ 18 years) receiving medical toxicology consultation for acute (or acute-on-chronic) drug exposures. Cases lacking ECG, known cardiovascular medical history, or laboratory values were excluded. Medical toxicologists provided bedside consultation for each patient and independently reported the primary agent(s) responsible for drug toxicity, which was used for drug-specific QT analysis. The primary outcome was SQTP, which was defined using the previously validated cut point [1] of 500 ms. Drugs associated with SQTP were analyzed with chi-squared, odds ratios (OR) and 95% confidence intervals (CI). Assuming 10% drug class exposure and 10% baseline SQTP risk, we calculated the need to enroll 5138 patients to have 90% power to detect 50% increased risk.
Results: From 18,438 patients screened, 5588 met inclusion criteria (49.6% female, mean age 38.9, 66.2% Whites, 13.7% Blacks, 1.8% Asians, 18.3% other/unknown, 9.9% Hispanic) with SQTP occurring in 469 (8.4%). The drug classification with the highest number of SQTP drugs was antidepressants ($n = 9$). The top three drugs with the highest risk of SQTP were imipramine (OR 76.8, CI 4–1500), sotalol (OR 21.9, 4–120), and nortriptyline (OR 12.9, 4–39). Haloperidol (OR 4.2, CI 1.5–12), quetiapine (OR 3.4, 2.4–4.6), and risperidone (OR 2.3, CI 1.0–5.1) were the only three antipsychotics associated with SQTP. Aside from Class III antidysrhythmics, sodium channel blockers, and known potassium channel blockers, novel drugs associated with SQTP included cyclobenzaprine (OR 3.6, CI 1.8–7.1), trazodone (OR 2.9, CI 2.0–4.1), clonazepam (OR 1.87, CI 1.1–3.2), and oxycodone (OR 1.8, CI 1.0–3.1).
Discussion: SQTP drugs notably did not include lithium, ondansetron, nor olanzapine. Implications for prescribing practices to prevent drug-induced QT prolongation require future study.
Conclusion: In this large US cohort, we have identified high risk drugs associated with SQTP, including novel associations with cyclobenzaprine, oxycodone, clonazepam, and trazodone.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

085. Hydroxychloroquine Poisoning and the Potential for Cardiotoxicity

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Background: Current management of hydroxychloroquine overdose extrapolates from the existing chloroquine literature given the chemical similarities of the two drugs, as well as from a few sparse case reports. It remains unclear, however, whether hydroxychloroquine causes similar cardiotoxicity as chloroquine in overdose.
Research Question: How commonly does hydroxychloroquine poisoning result in QRS and QTc prolongation, arrhythmias, or death?
Methods: All hydroxychloroquine cases reported to our regional poison center (RPC) were retrospectively queried over a nine-year period (June 2008—September 2017). All cases with a history of hydroxychloroquine exposure with follow-up were included. Demographic data (age, sex, coingestants, unintentional versus intentional), electrocardiographic results (QRS and QTc intervals), arrhythmias, and deaths were analyzed by two trained and monitored abstractors.
Results: A total of 165 hydroxychloroquine cases were identified. Kappa was 1.0. Of these, 81 (49%) were managed at home and 84 (51%) in the emergency department. Average age was 29 years (range 9 months—91 years) and 45 patients were ≤ 5 years. Majority were female: 118 females (72%) and 47 males (28%). Coingestants were reported in 71 (43%) cases. In 41 (25%) patients, the cause was unintentional and in 115 (70%), intentional. In 9

(5%) patients, the cause was unknown. In 69 of 84 cases seen at a hospital, an EKG was recommended and 58 had EKGs on follow-up. QRS intervals ranged from 66 to 120 ms. A QRS interval greater than 100 ms was recorded in 12 patients (7% of all cases). QTc intervals ranged from 388 to 644 ms. In 12 patients (7% of all cases), a QTc greater than 450 ms, but less than 500 ms was reported. In 13 patients (8% of all cases), a QTc above 500 ms was documented. None developed arrhythmias or died.
Discussion: Despite 7–8% of patients having QRS or QTc prolongation, none developed arrhythmias or died. Limitations included reporting bias, missing data, coingestants, and patients lost to follow-up.
Conclusion: Hydroxychloroquine may cause EKG abnormalities, and further studies are needed directly comparing hydroxychloroquine to chloroquine to better understand the development of cardiotoxicity in overdose.

086. Delayed Cardiotoxicity After Acute Bupropion Overdose

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Background: Bupropion toxicity frequently results in seizures and myoclonus. Cardiotoxicity after large overdoses is described as well. Rarely, coma with absent brainstem reflexes can occur after massive overdoses. We present the largest reported ingestion of bupropion with delayed cardiotoxicity, absent brainstem reflexes, and a confirmatory level.
Methods: Single-patient chart review.
Case: An 18-year-old female with a history of social anxiety, bipolar disorder, and depression was found unconscious 9 h after ingesting 27 g of bupropion. Her initial ED vitals were significant for heart rate of 134 bpm. She was lethargic and drowsy but subsequently developed status epilepticus refractory to benzodiazepines, requiring intubation. She received 100 g of activated charcoal and was transferred to our tertiary center for possible ECMO. Physical exam was significant for 5 mm reactive pupils. Initial EKG was significant for sinus tachycardia with normal intervals. Whole bowel irrigation was performed for 13 h. Approximately 20 h post-ingestion, her blood pressure dropped to 77/49 mmHg with a heart rate of 80 bpm. She remained hypotensive on an epinephrine infusion and was given intravenous lipid emulsion (ILE) bolus plus continuous infusion for approximately 6 h. Her blood pressure stabilized to 90/50 mmHg. After 24 h, she was weaned off vasopressors. During the hemodynamic instability, her QRS widened to 130 ms and QTc prolonged to 710 ms, necessitating a sodium bicarbonate infusion for 20 h. She exhibited a prolonged comatose state with fixed and dilated pupils and burst suppression on EEG for 3 days. She slowly regained purposeful movement and was extubated on hospital day 6. She was medically cleared on hospital day 11 neurologically intact. The bupropion level from day 1 resulted at 710 ng/mL (50 ng/mL upper limit) and hydroxybupropion was 9200 ng/mL (500 ng/mL upper limit).
Discussion: Our case presents the largest reported bupropion ingestion with associated delayed cardiotoxicity. Absent brainstem reflexes and burst suppression on EEG can be seen, but this should not preclude aggressive resuscitative measures, nor should it indicate a dire prognosis. The treatment utilized in this case demonstrates the importance of aggressive decontamination and possible benefit of ILE in bupropion overdose.

087. Digoxin Recrudescence: a Life-Threatening Reality for End-Stage Renal Disease Patients

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Background: Digoxin-poisoned patients with end-stage renal disease (ESRD) free digoxin concentrations may rise days after treatment with digoxin Fab, creating the potential for recrudescence of digoxin poisoning.
Methods: Single-patient chart review.
Case: Results: A 53-year-old man with ESRD on dialysis, atrial fibrillation, and heart failure on digoxin, presented after he was found to be bradycardic. Initial vital signs were: BP, 176/89 mmHg; HR, 32 bpm; RR, 16 bpm; O_2 saturation, 100% on room air. ECG showed slow atrial fibrillation with scooping ST segments in V2–V3 with accompanying U waves. He reported nausea, emesis, anorexia, and fatigue. Laboratory assessment was significant for a total digoxin concentration of 4 ng/mL (last dose 24 h prior to arrival), potassium of 4.2 mEq/L, and Cr of 3.29 mg/dL. The patient (68 kg) was treated with three vials of digoxin-specific Fab fragments and admitted to critical care. Status-post digoxin Fab treatment, HR increased to 60 bpm. On hospital day 3, repeat total digoxin concentration was 4.0 ng/mL. At that time, VS were notable for BP, 178/96 mmHg; HR, 45 bpm. ECG demonstrated atrial fibrillation at 45 bpm, which improved over the next 24 h without intervention. He was transferred out of intensive care and discharged home on hospital day 16 off digoxin.
Discussion: The therapeutic concentration of digoxin is dependent on normal kidney function as it is primarily renally eliminated. In the setting of ESRD, digoxin is cleared through a poorly understood, non-renal mechanism. Expert opinion supports hepatic clearance as the main mechanism in ESRD patients. Neither digoxin nor digoxin-specific Fab fragments are dialyzable. Due to delayed clearance and preferential metabolic degradation of digoxin Fab, dissociation of free digoxin from the Fab complex is reported in ESRD patients. This creates the potential for recrudescence of digoxin toxicity days after Fab treatment and should be considered by providers when determining an appropriate observation time for digoxin-poisoned patients with poor renal function.
Conclusion: Due to the elimination kinetics for ESRD patients and selective Fab degradation, ESRD patients taking digoxin are at potential risk for recrudescence and subsequent digoxin toxicity.

088. The Frequency of Seizures After Exposure in Cases with QRS Interval Prolongation

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Background: Various toxicological exposures cause both prolongation of the QRS interval in addition to seizures. However, it is unclear which substances are most likely to result in the development of seizures in association with QRS interval prolongation. The purpose of this study was to determine the frequency of exposures causing prolongation of the QRS interval also resulting in seizures, using the Toxicology Investigators Consortium (ToxIC) registry.
Research Question: Does exposure to agents causing prolongation of the QRS interval increase likelihood of seizures?
Methods: This is a retrospective review of prospectively collected registry data. All cases between December 31, 2013 and January 1, 2017 leading to QRS prolongation (defined as a QRS > 120 milliseconds) were extracted from the ToxIC database. From this dataset, the data was distilled to include exposures causing seizure activity. Using this data, the most common agents causing seizure were identified. The data also included age, gender, clinical symptoms and primary toxic exposures, which was then reviewed and statistically analyzed.
Results: There were 397 cases of QRS prolongation identified. The mean age was 32.4 years (range < 2–89 years) and 216 (54.4%) were male. Of the 397 cases that had exposures causing QRS prolongation, 77 (19.4%) of these cases were accompanied by a seizure. Of these 77, the three most common exposures that resulted in seizures were bupropion ($N = 15$, 19.5%), amitriptyline ($N = 11$, 14.3%) and diphenhydramine ($N = 8$, 10.4%). In cases of QRS prolongation 65.2% bupropion, 30.8% diphenhydramine and 15.9% amitriptyline exposures resulted in seizures. There were 29 deaths in the cohort.
Discussion: While both ventricular conduction and neuronal excitability are directly related to voltage-gated sodium channel dysfunction, it is unknown which substances cause the highest proportion of seizure in association with QRS prolongation. This study identified bupropion, diphenhydramine and

amitriptyline use resulting in QRS prolongation as the most common agents associated with seizures. Interestingly, bupropion exposures causing QRS prolongation resulted in seizures 65.2% of the time.
Conclusion: Although it appears that there were numerous instances of seizures in exposures that also caused QRS prolongation, additional studies need to be performed to evaluate causality.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

089. Characteristics of Corticosteroid Use Across Various Toxic Exposures

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Background: Corticosteroids are used for many acute and chronic diseases across many specialties. Corticosteroid use, however, as therapy for toxicologic exposures is not well described. Therefore, the purpose of this study is to characterize corticosteroid use as practiced by medical toxicologists for toxic exposures using the Toxicology Investigators Consortium (ToxIC) registry.
Research Question: In what exposures do toxicologists use corticosteroids as treatment?
Methods: This is a retrospective review of prospectively collected registry data. All cases from January 1, 2010 to January 1, 2017 in which corticosteroids were administered as a treatment and were documented as such in the ToxIC database were extracted and analyzed. Age, gender, primary exposures, treatments administered, chronicity, clinical signs, and symptoms and outcomes were collected. Descriptive statistics were performed.
Results: There were 303 cases identified, and of these, the mean age was 34.2 years (range was < 2–89 years) and 171 (56.4%) were male. Of the 303 cases in which corticosteroids were used for treatment, the most common exposures were envenomations ($N = 67$, 24.2%), analgesics ($N = 20$, 7.2%), opioids ($N = 18$, 6.5%), and gas/vapor/irritant/dust ($N = 16$, 5.8%). Corticosteroids were used in 14 (5.1%) household exposure and in 13 (4.7%) caustic exposures. There were 26 (8.6%) cases of corticosteroid use without documentation of the specific exposure. Interestingly, in 24 of the envenomation cases, corticosteroids were given with administration of antivenom. The three most frequently used treatments in conjunction with steroids were *N*-acetylcysteine ($N = 28$), CroFab ($N = 24$), and sodium bicarbonate ($N = 21$). There were 15 deaths in the entire cohort.
Discussion: Cases involving envenomations received corticosteroid treatment most commonly. Some have argued that corticosteroids in combination with antivenom may be effective in decreasing local tissue edema, thereby reducing incidence of sequelae. Others support use of corticosteroids in the treatment of anaphylaxis secondary to serum sickness after administration of antivenom. Corticosteroid use in other toxicologic exposures such as in analgesics, opioids, and antimicrobials is reported without clear indication.
Conclusion: Indications for corticosteroid use in toxic exposures need to be studied further.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

090. Age Versus DRE Impairment: Is There Reasonable Doubt?

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Background: The Drug Recognition Expert (DRE) program was established by law enforcement to evaluate impaired drivers who test below the per se limit for ethanol. The DRE determines if the suspect is impaired by one or more drugs in the following categories: CNS depressants, CNS stimulants, hallucinogens, dissociative anesthetics, narcotic analgesics, inhalants and cannabis. DRE assessment of impairment is verified by a urine drug test. Impairment is assessed by observations of horizontal and vertical nystagmus, convergence, smooth pursuit, pupil size and reactivity, modified Romberg, walk and turn, one leg stand, finger-to-nose, muscle tone and vital signs: blood pressure, temperature, and pulse. DRE ability to apply these data to formulate an accurate assessment of impairment is based upon published validation studies.
Research Question: Did the DRE validation studies control for the effects of aging?
Methods: We conducted a search for all published studies in the peer reviewed literature that claim to validate DRE accuracy. Study methods were reviewed to determine the number of subjects and controls, and the age ranges for subjects in each study.
Results: Seven studies were found that describe DRE evaluations on drug-exposed subjects. Two studies comprise a retrospective review of DRE conclusions on 219 and 500 arrestees with an age range of 21–70 years. Four studies reported 18, 48, 80 and 250 subjects with no subject older than 40 years. There were no control subjects in any of these six studies. Only one of the seven studies reported drug exposed subjects ($n = 302$) and a non-exposed control group ($n = 282$) with an age range of 15–59 years, but subjects and controls were not age matched.
Discussion: None of the published DRE validation studies considered the influence of age upon the impairment measures, despite a wealth of data that demonstrate age-related effects in almost every finding relied upon by the DRE to form a conclusion of impairment.
Conclusion: DRE validation studies lack proper controls. Conclusions of impairment cannot be generalized to a population older than the study subjects.

091. Behavioral Determinants Influencing the Decision of Intensivists to Call Poison Centers for Calcium Antagonist Poisoning

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Background: Behavioral determinants contributing to the decision to call poison control centers (PCCs) are unknown. A retrospective chart review of calcium channel blocker (CCB) poisonings reported that physicians called in only 74% of cases. A better understanding of what influences clinicians to call PCCs might improve implementation of treatment recommendations.
Research question: To determine intensivists' behavioral determinants to call PCCs when managing CCB poisonings.
Methods: We recruited a convenience sample of intensivists in two Canadian provinces by sending invitations to members of the Canadian Critical Care Society and to members of academic Departments of Intensive Care Medicine in Quebec and Ontario. We conducted semi-structured interviews until we reached data saturation. Two independent reviewers performed qualitative content analysis of the transcripts using the Theoretical Domains Framework. Each reviewer identified the most relevant behavioral determinants based on their perceived impact and the frequency of their reporting. We also classified each behavioral determinant as having a positive or negative influence on physicians' intention to call PCCs. We resolved disagreements through discussion.

Results: We interviewed 18 intensivists (15 [83%] were male) from nine different academic Intensive Care Units in Quebec and Ontario with different levels of experience (8 [44%] with less than 5 years, 4 [22%] with 5–10 years and 6 [33%] with over 10 years of experience) and primary specialty training (10 [56%] Internal Medicine, 7 [39%] Anesthesiology and 1 [5%] Respirology). We identified positive behavioral determinants in the following domains: *knowledge*, *social/professional role and identity*, *reinforcement*, *intention*, *goals*, *memory, attention and decision process* and *behavioral regulation*. We identified negative behavioral determinants in the following domains: *knowledge*, *skills*, *belief about capabilities*, *goals*, *memory, attention and decision process*.
Discussion: We identified behavioral determinants that will help design strategies to increase intensivists calling PCCs in cases of CCP poisoning. This could help PCCs better guide intensivists in the management of complex poisonings. We will need to further explore if our results are applicable to clinicians in community hospitals and to other types of poisonings.
Conclusion: This study will help PCCs design support services adapted to the needs of intensivists when treating CCB poisonings.

092. Sex Differences in Poisonings Among Older Adults: an Analysis of the Toxicology Investigators Consortium (ToxIC) Registry: 2010–2016

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Background: Older adults are susceptible to both intentional and accidental poisoning with contributing factors including polypharmacy, comorbidity, susceptibility to medication error and gaps in research. Little is known about sex differences among older adults with poisonings managed at the bedside by medical toxicologists.
Hypothesis: The aim of this study is to review sex differences in poisonings among older adults.
Methods: All cases age > 65 years in the Toxicology Investigators Consortium (ToxIC) registry between 1/2010–12/2016 were reviewed. Abstracted data included reasons for exposure and consultation, exposure agents, and routes, presenting clinical findings, and treatment provided. Cases missing age, sex, or primary reason for toxicologic consult data were excluded. Chi-square tests were used to assess differences in distribution of study variables by participant sex. All analyses were performed with Stata SE v14.2. Study was IRB exempt.
Results: five hundred forty-two of a total of 51,441 cases (1.05%) were excluded due to missing data. Among the remaining 50,899 cases, 2930 (5.8%) cases were included for age > 65 years. 52.3% of the older adults were female. Race was missing or unknown for 49.2% of cases. Females presented more frequently than males for intentional pharmaceutical exposures (36.4 versus 32.0%, $p = 0.01$). No sex differences were observed for intentional non-pharmaceutical or unintentional pharmaceutical and non-pharmaceutical exposures. Most common medications involved in cases were cardiovascular (16.8%) followed by analgesics/opioids (14.8%). Females were more likely than males to require management for cardiovascular medications (18.7 versus 14.7%, $p = 0.004$) and analgesics/opioids (17.6 versus 11.8%, $p < 0.001$). The most common route of exposure was oral ingestion (81.3%). Signs/symptoms were noted in 41.0% of cases, with the most common abnormal vital sign: bradycardia (17.2%). Medical interventions were more common in males (25.1 versus 21.1%, $p = 0.01$)—pharmacologic support was the most common intervention (17.7% males versus 12.3% females, $p < 0.001$). Deaths were reported in 38 female and 46 male patients.
Discussion: Females were more commonly treated by a medical toxicologist for intentional pharmaceutical exposures than males. Despite this finding, males more frequently received pharmacologic support.
Conclusions: Sex differences among older adult poisoning cases were found for intentional pharmaceutical exposures.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

093. Serotonin Toxicity Secondary to Tianeptine Overdose

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Background: Tianeptine is an atypical antidepressant that is structurally similar to tricyclic antidepressants (TCAs) but possesses a distinct pharmacologic profile. In contrast to selective serotonin reuptake inhibitors and TCAs, there is evidence that tianeptine increases serotonin reuptake in the brain.
Hypothesis: Tianeptine is capable of producing serotonin syndrome.
Methods: Single-patient chart review.
Case: A 23-year-old male presented to the emergency department after experiencing a seizure following ingestion of an unknown quantity of tianeptine sodium powder obtained online. The patient developed agitation, hyperthermia, tachycardia, hypertension, tremors, clonus, rigidity, hyperreflexia, hallucinations, and rhabdomyolysis over the course of his 7-day hospital stay. The patient initially received a total of lorazepam 10 mg intravenously and a dexmedetomidine infusion for sedation. He remained severely agitated, and was intubated and sedated with propofol at 40 mcg/kg/min, but also required additional intravenous midazolam, lorazepam, and valproic acid to control agitation. Propofol was eventually replaced with dexmedetomidine. Metoprolol and clonidine were given for blood pressure and heart rate control. Dantrolene 20 mg was administered orally every 6 h for clonus in contrast to toxicologist recommendations. The patient's mental status improved on hospital day two and he was extubated on day three. His creatine kinase peaked at 28,000 mg/dL. His maximum blood pressure, heart rate, and temperature were 167/111 mmHg, 154 bpm, and 100.8 °F, respectively. The patient was discharged on day seven with return to baseline mental status, improvement of musculoskeletal findings, and down-trending creatine kinase.
Discussion: Tianeptine is not currently approved for use in the USA, and its exact mechanism of action is unknown. It is reported to increase serotonin reuptake centrally; however, this case report demonstrates that symptoms of serotonergic toxicity (e.g., altered mental status, autonomic instability, clonus, tremor, hyperreflexia, hyperthermia) are possible secondary to tianeptine ingestion. To our knowledge, this is the first published report of tianeptine-induced serotonin toxicity.
Conclusion: Tianeptine overdose can cause serotonin toxicity and patients may require high doses of sedative medications to control serotonergic symptoms.

094. Characteristics of Toxic Exposures in HIV-Positive Patients Reported to the Toxicology Investigators Consortium

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Background: Most research regarding toxic exposure and HIV-positive patients addresses overdose only in the setting of drug abuse. Little has been previously reported regarding characteristics of exposure outside of the drug abuse setting. In 2015, the ToxIC registry added an optional data field regarding HIV status.
Research question: What are the encounter types and agents of exposure in HIV-positive patients?
Methods: This is a prospective study performed using multi-center data collected in the ToxIC Registry from January 1, 2015 to August 31, 2017. All known HIV-positive patients were included. Descriptive statistics were used to report the types and frequency of exposure. We also report the top five agent classes and agents associated with exposure.
Results: There were a total of 21,504 cases reported to the registry during this time. HIV status was known in 1151 cases, and of these, 206 (18%) were HIV-positive. The top encounter types in HIV-positive patients are intentional pharmaceutical (48.1%), intentional non-pharmaceutical (28.1%), opioid withdrawal (5.3%), organ system dysfunction (4.4%), and unintentional pharmaceutical (2.9%). For intentional pharmaceutical, 65.6% are due to self-harm, 18.2% for misuse/abuse, and 11.1% for therapeutic use. For intentional non-pharmaceutical, 67.2% are misuse/abuse. The top five agent classes are sympathomimetics (20%), antidepressants (18.9%), opioids (17.1%), analgesics (14.3%), and sedhypnotic/muscle relaxants (13.1%). The top five agents are methamphetamine (10.2%), ethanol (9.7%), heroin (9.1%), acetaminophen (8%), and cocaine (6.3%).
Discussion: Drugs of abuse were highly represented among agents of exposure in HIV-positive patients. In comparison, the exposure for the same agents in all-comers in the 2016 ToxIC registry annual report were methamphetamine (2.1%), ethanol (8.1%), heroin (3.7%), acetaminophen (11.6%), and cocaine (2.9%). The top five agents of exposure in the 2016 report were acetaminophen, ethanol, diphenhydramine (4.9%), heroin, and quetiapine (3.6%). A limitation of our study is that 85% of patients in the ToxIC registry had unknown HIV status.
Conclusion: Most encounters in HIV-positive patients are due to intentional pharmaceutical and non-pharmaceutical exposures. The most frequently reported agents of exposure are methamphetamine, ethanol, heroin, acetaminophen, and cocaine.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

095. Most Common Substances Used in Single-Product Suicidal Poisonings in the USA

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Background: Poisonings are the leading method of suicide attempt in the USA and medical costs for inpatient medical treatment exceeded $2.1 billion in 2015. Studies of substances used have reported either medication classes (with common exceptions being acetaminophen, ibuprofen, and ethanol) or agents within specific classes of psychiatric medications only. The former approach does not provide information on specific products while the latter excludes individuals without previous psychiatric treatment.
Research Question: To determine the most common specific substances used in single-product suicidal poisonings.
Methods: This is a descriptive study of suicidal human exposures reported to the National Poison Data System from 2011 to 2015, with confirmed non-exposures excluded. Data included demographic information about the patient, exposure substance(s) with product names, clinical effects of concern (central nervous system [CNS] depression, seizures, conduction disturbances, hypotension, and death), and intubation. Descriptive statistics were used.
Results: There were 642,175 single-product suicidal poisonings. The 10 most common products were all medications and accounted for 38% of the total cases. The top three were over-the-counter (OTC) products: acetaminophen (7.0% of cases), ibuprofen (6.4%), and diphenhydramine (4.4%). Together with aspirin (#8; 2.7%), they comprised four of the top 10 and 20.5% of total cases. Of the top 10, diphenhydramine had the highest seizure rate (4.4%) and an increased rate of conduction disturbances (5.5%). Quetiapine, ranked fourth, was the most common prescription medication and had the highest rates of CNS depression (64%), conduction disturbance (7.6%), hypotension (12%), and intubation (8.7%). Also among the top 10, aspirin had the highest admission rate (54%). Aspirin and acetaminophen/hydrocodone had the highest death rates (0.42%).
Discussion: OTC products comprised a considerable proportion of single-product suicidal poisonings and several had concerning rates of seizures, conduction disturbance, and death. Quetiapine had high rates for many of the clinical effects studied. This information can help inform education and prevention efforts, particularly related to OTC versus prescription medications. Limitations include the absence of mandatory reporting of suicide attempts and lack of confirmatory testing in most cases.
Conclusion: These findings can help educate healthcare providers and direct future research efforts and development of lab resources.

096. Does the Availability of Preformatted Text in Discharge Instructions Result in Improved Rates of Holding Metformin in Emergency Department Patients Receiving an IV Contrast CT Study?

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Background: As diabetic patients have been determined to be at increased risk for radiocontrast-induced acute renal failure, having patients on metformin hold their medication for 48 h after an IV contrast study and then having renal function rechecked before restarting metformin, has become a generally accepted recommendation. It is unclear how often this recommendation is actually followed in patients discharged from the emergency department after an IV contrast CT scan.
Study Question: Does the availability of preformatted text in discharge instructions result in improved rates of holding metformin in emergency department patients receiving an IV contrast CT study?
Methods: Retrospective review of charts from an urban, Level 1 trauma center with 105,000 emergency department visits per year. A best-practice alert advising holding metformin had been in place for 2 years prior to our study, but rates of providing the appropriate instructions were about 20%. Six months of charts were reviewed from the period before the availability of the metformin-specific preformatted text that could be easily inserted into the discharge instructions using a SmartPhrase and 6 months of data after its availability. Eligible patients were > 18 years of age, on metformin, were not admitted, received IV contrast and had

signed discharge instructions available. The charts were abstracted by the author and all data was de-identified pursuant to IRB requirements.
Results: A total of 164 charts met inclusion criteria, 99 from the pre-text group and 65 from the post-text group. One hundred nine CT scans were performed for medical reasons and 55 for trauma-related concerns. Rates of receiving the discharge instructions did not substantially change after the availability of the preformatted text (18/99 or 18.1% in the pre-text group and 13/65 or 20% in the post-text group). Ten of the post-text instructions were clustered in the beginning of the post-text period.
Discussion: Despite adding a preformatted text that could be easily inserted into discharge instructions advising holding metformin and having renal function rechecked, adherence to the placing the recommendations in discharge instructions was poor, suggesting there were additional reasons beyond ease of insertion of the appropriate text.

097. Main Predictors for Repetition of Suicidal Behavior Among Women Referred to a Single Public Sector Tertiary Care Hospital in Iran

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Objective: To assess the main predictors for repetition of suicidal behavior among women.
Methods: This cross-sectional study was conducted at Loghman Hakim Hospital, Tehran, Iran, in 2014, and comprised women patients. The patients were divided into two groups, i.e., women repeating suicide and women without repeating suicide. Data was collected through a checklist and then analyzed with SPSS 20 software.
Results: Of the 300 women, 121 (40.3%) repeated suicide and 179 (59.7%) did not. The overall mean age was 26.9 ± 9.1 years (range 14–80 years). High prevalence of psychological drug usage, alcohol use, history of self-mutilation (self-harm), psychotic disturbances, sexual relationships, smoking, and opium addition was revealed as major factors in repeated suicidal behavior in women when compared with other women. The result of multivariate logistic regression model showed two factors of self-mutilation (odds ratio = 2.692, $p = 0.002$) and underlying psychotic disorders (odds ratio = 2.780, $p < 0.001$) as main predictors of suicide in women. In this regard, demographic characteristics could not predict repeating suicidal attempts ($p > 0.05$).
Conclusion: The presence of underlying psychotic disorders and self-mutilation were main predictors for repetition of suicidal behavior.

098. The Undifferentiated Becomes Obvious: The Perfect Timeline

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Background: Metformin-associated lactic acidosis (MALA) is well described, usually with chronic use in the setting of renal dysfunction. With less than 10 cases per 100,000 patient-years, the incidence is rare.
Methods: Single-patient chart review illustrating the timeline of severe acute MALA from a single ingestion in a metformin-naïve patient.
Case: One-hour post-ingestion
A 22-year-old female presented within 1 h of an intentional ingestion. Providers were presented with three empty unlabeled prescription bottles. In the first hours, patient was nauseous with normal mental status. Initial labs were unremarkable for metabolic or electrolyte derangements and an EKG had normal intervals.
Four hours post-ingestion
Patient abruptly developed delirium, mydriasis, anhidrosis, flushing, absent bowel sounds tachycardia, and hypertension. Administration of physostigmine improved delirium. Repeat labs revealed an anion gap metabolic acidosis (AGMA) and she developed a prolonged QTc.
Five hours post-ingestion
Patient became lethargic and tachypneic with worsening AGMA. Lactate was found to be 18.1 mmol/L and venous pH was 6.9. Sodium bicarbonate was administered.
Six hours post-ingestion
Patient became hypotensive and unresponsive. Fluid boluses and sodium bicarbonate infusion were initiated. She was intubated with mechanical hyperventilation and vasopressors were started. High-volume urine output was observed.
Eight to 10 hours post-ingestion
Repeat labs revealed worsening AGMA, increasing lactate, and acute hypoglycemia. Bedside ultrasound revealed grossly normal cardiac inotropy and patient was warm peripherally. Patient had a positive hemodynamic response to calcium gluconate, though EKG had prolongation of QRS and QTc.
Thirteen hours post-ingestion
Patient developed profound hypothermia and lactate increased to 33 mmol/L. Despite sodium bicarbonate infusion and hyperventilation, there was no improvement of acidosis. Family presented prescription labels for metformin, ibuprofen, and meloxicam.
Fifteen hours post-ingestion
Hemodialysis was initiated with rapid complete recovery.
Discussion: We present an acute undifferentiated ingestion with delayed altered mental status, tachypnea, acidosis, hypotension, hypoglycemia, hypothermia, normal cardiac inotropy, and insidious increase of lactate, requiring hemodialysis due to MALA. No patients in a previous study of 234 patients with MALA (22 deaths) developed this level of serum lactate. This is the first real-time description of a potentially lethal acute metformin overdose with corresponding clinical context.

099. Retrospective Review of Wernicke Encephalopathy and Thiamine Deficiency

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Background: Wernicke encephalopathy is caused by thiamine deficiency and is perceived to be of decreased prevalence due to preventive measures including thiamine administration to alcoholics.
Research Question: What are the circumstances, recognition, and treatment of Wernicke's encephalopathy in the contemporary era?
Methods: This is a descriptive retrospective chart review of the shared Electronic Health Records of an eight-hospital system. Records were searched from 2006 to 2015 for ICD9 codes for Wernicke encephalopathy and thiamine deficiency. Charts that met these criteria were reviewed. Data was entered into a structured spreadsheet including demographic data, chief complaint, orientation, extra-ocular eye examination, results of brain MRI and CT, thiamine level, time from arrival to administration of thiamine and glucose, past medical history, surgical history, and categories that can lead to thiamine deficiency including alcoholism, gastric bypass or bowel resection surgery, hyperemesis gravida, and eating disorders. Institutional Review Board consent was obtained. Statistical analysis was not performed.
Results: Two hundred eighty records were obtained and 122 that met the inclusion criteria were identified. One hundred fifty-eight charts had no evidence of Wernicke encephalopathy or a low thiamine level and were classified as miscoded. A review of the 122 charts found that 30 had a prior diagnosis of Wernicke encephalopathy, 13 had a diagnosis of nutritional deficiency, 70 had a low thiamine level, and nine patients presented with a new diagnosis of Wernicke encephalopathy. Of those with a low

thiamine level or a diagnosis of Wernicke encephalopathy, the cause was alcoholism in 29 (27%), gastric bypass/bowel resection surgery in 18 (17%), and hyperemesis gravida in one (< 1%). Otherwise, no likely cause was reported. Ten patients received glucose before thiamine, but no adverse reactions were recorded.
Discussion: Alcohol abuse was the most common cause of Wernicke encephalopathy in this population, followed by gastric bypass or bowel resection. Hyperemesis gravida was the cause in one case. While there has been a perceived decrease in the prevalence of Wernicke encephalopathy, cases continue to occur.

100. Severe Vitamin D Toxicity Resulting in Prolonged Hypercalcemia, Acute Kidney Injury, and Renal Phosphate Wasting

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Background: Vitamin D toxicity is relatively rare in the USA. Hypervitaminosis D can cause acute and chronic kidney damage as a result of increasing serum calcium levels leading to kidney stones and calcifications of the renal tubules. Vitamin D is a fat-soluble hormone that can be sequestered into fat cells and can slowly leach from the fat stores for extended periods after cessation of vitamin supplementation.
Hypothesis: As a fat-soluble vitamin, Vitamin D3 will persist for months even after cessation of vitamin D supplementation.
Methods: Single-patient chart review.
Case: A 40-year-old woman with multiple sclerosis (MS) presented with fatigue, lower extremity edema, and severe hand and foot pain. Initial workup revealed a serum calcium of 16.1 mg/dL and acute kidney injury (AKI) with a serum creatinine of 3.2 mg/dL (baseline 0.7 mg/dL). She reported taking a regimen of 300,000 units of cholecalciferol daily in order to treat her underlying MS while following a strict low-calcium diet and consuming 3 L of water daily. Further laboratory values obtained at her initial presentation revealed a 25-OHD of 555 ng/dL, a 1,25-OH_2D of 167 pg/dL, and an FGF-23 of 1150 RU/mL. The patient was hospitalized and treated with intravenous saline. During her hospital stay, she developed renal phosphorus wasting and hypophosphatemia requiring phosphate supplementation. Her creatinine improved to 2.2 mg/dL and hypercalcemia stabilized at 11 mg/dL during a 7-day hospitalization. At this time, she agreed to stop her supplementation regimen. Over the next 3 months without interval cholecalciferol ingestion, her 25-OHD and 1,25-OH_2D levels slowly decreased to 189 ng/dL and 43 pg/dL respectively, with slow resolution of hypercalcemia and AKI.
Conclusion: When monitoring cases of severe vitamin D toxicity, follow-up should be sought for months as very elevated levels of vitamin D may persist even after cessation of vitamin supplementation.

101. Transdermal Selegiline Delivery System Exposures: Characteristics and Outcomes Reported to the NPDS over 10 Years

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Background: A transdermal selegiline delivery system (TSDS), marketed as EMSAM, was FDA approved in 2006 for the treatment of major depressive disorder. TSDS has the potential to cause significant toxicity due to the large amount of drug it may contain and its extended-release properties. There is no published literature detailing exposures to TSDS. We sought to characterize TSDS exposures reported to the National Poison Data System (NPDS).
Hypothesis: Exposures to TSDS are associated with significant morbidity or mortality.
Methods: This was a cross-sectional study consisting of NPDS data collection utilizing both qualitative and quantitative data for the time period of 1/1/2006 to 1/1/2016. A qualitative analysis of NPDS fatality abstracts was conducted to characterize all human exposures to TSDS. A quantitative search in NPDS was conducted for all closed, human exposure cases to TSDS. All data entered into NPDS was collected and analyzed using Microsoft Excel (*Microsoft Corp., Redmond, Washington*, 2010).
Results: A total of 214 cases were identified. There were 13 pediatric cases [mean age 11.6 years (SD 5.9)] and 201 adult cases [mean age 41.3 years (SD 14.0)]. There was a peak of 42 exposures in 2007. The majority of exposures involved females ($n = 142$) and exposures to multiple substances ($n = 137$). Unintentional exposures were most common ($n = 88$), while 60 cases (28%) were intentional. Dermal exposure was documented in 112 (52%) cases. Patch ingestion was documented in 24 cases. The majority of cases ($n = 137$) were managed at a health care facility. Forty-nine (23%) cases were admitted to critical or non-critical care units. One hundred eighteen cases (55%) were followed to a known medical outcome: 12 major, 49 moderate, 30 minor, and 25 no effect. Of symptoms documented as being related to the exposure, drowsiness/lethargy was the most common ($n = 25$). Eight cases of hyperthermia were documented. No seizures were documented. There were two deaths: an 18-year-old and a 40-year-old, and both cases involved multiple substances.
Conclusions: TSDS exposures are infrequently reported to the NPDS, usually involve other substances, and can be associated with significant morbidity and rare mortality.

102. Central Nervous System Excitation and Metabolic Acidosis as a Delayed Presentation of Gabapentin Overdose

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Background: Gabapentin is a commonly prescribed xenobiotic that is generally considered safe with few adverse effects. However, it is an emerging drug of abuse and is increasingly identified in post-mortem toxicologic assays. Although anecdotal reports of seizure following gabapentinoid overdoses have been reported, cases specific for gabapentin have not been documented.
Hypothesis: CNS excitation may occur as a delayed presentation of gabapentin overdose.
Methods: Single-patient chart review.
Case: A 33-year-old woman on chronic gabapentin therapy had a witnessed loss of consciousness with generalized tonic-clonic movements 7 h after single recreational ingestion of 24 g of gabapentin and presented to the emergency department. She had a total of eight further witnessed tonic-clonic episodes followed by periods of drowsiness. These episodes were associated with apnea, cyanosis, and desaturations to 60% SpO2 requiring BVM, as well as concurrent tachycardia. She was treated with escalating doses of lorazepam and required hospitalization, but left against medical advice 25 h after her overdose. Initial laboratory studies showed a metabolic acidosis with bicarbonate of 18 mmol/L and lactic acid level of 13 mmol/L. CPK testing revealed interval elevation from 86 U/L at presentation up to 202 U/L 4 h later. Serum gabapentin level 13 h after ingestion was 9.5 mcg/mL. Her metabolic workup was otherwise unremarkable. Urine gas chromatography/mass spectroscopic evaluation did not show any other substances to explain her presentation. Urine buprenorphine and marijuana screen were positive. Workup for alternative toxic ingestions and other causes of altered mental status and metabolic acidosis were negative. She had no personal or family history of seizure.
Discussion: Gabapentin alters normal neurophysiology through broad CNS effects including stimulation and upregulation of glutamate decarboxylase, binding and closing of voltage-gated calcium channels, and dose-dependent NMDA receptor antagonism. Serum gabapentin levels

are incompletely studied, but documented range after multiple daily doses up to 1800 mg at a time have been measured to not exceed 8.5 mcg/L. When levels were checked in this case approximately two half-lives from time of ingestion, they remained markedly supratherapeutic despite excellent renal function.
Conclusion: We describe a case of gabapentin overdose with delayed effects of CNS excitation and metabolic acidosis.

103. Serotonin Toxicity from Isolated Paroxetine and Hydroxyzine Overdose

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Background: Paroxetine is a selective serotonin reuptake inhibitor (SSRI) that is commonly used to treat depression, and can be associated with serotonergic toxicity in combination with other serotonergic agents, but has not been described to cause serotonin syndrome in isolation.
Hypothesis: Paroxetine can cause serotonin syndrome in overdose without additional serotonergic agents.
Methods: Single-patient chart review.
Case: A 35-year-old man with a history of depression was found by his parents acting increasingly altered in the 24 h after filling his monthly prescription medications and later stated he had overdosed on his paroxetine and hydroxyzine alone. He was taken to a community hospital where he was delirious, with lower extremity rigidity, agitation, and bilateral ankle clonus, as well as rhabdomyolysis (CK = 42,670 IU/L) on laboratory testing. He was intubated, placed on a midazolam infusion, and admitted to the ICU. He received intravenous phenytoin for possible seizure activity. He was subsequently transferred to a tertiary care center when he did not show improvement on hospital day three and, upon arrival, was found to have lower extremity rigidity, persistent spontaneous bilateral ankle clonus and hyperreflexia consistent with serotonin syndrome. The patient was transitioned from propofol to dexmedetomidine and extubated on hospital day four, and ankle clonus resolved on hospital day six. The patient was medically cleared for discharge to inpatient psychiatric facility on hospital day seven. Urine drug screen was positive for opiates and benzodiazepines and gas chromatography-mass spectroscopy urine testing was positive only for large peaks of paroxetine and hydroxyzine and smaller peaks of caffeine, codeine, midazolam, propofol and phenytoin.
Discussion: As an SSRI, paroxetine has the potential to cause serotonin toxicity that has yet to be reported without additional serotonergic agents. No other serotoninergic compounds were found during toxicologic screening. Additionally, the structural similarity of hydroxyzine with the serotonergic acting tricyclic antidepressant xenobiotics may have caused amplification of serotonin toxicity in massive overdose, but hydroxyzine is not known to have any serotonergic properties.
Conclusion: Paroxetine alone may cause serotonin toxicity in massive overdose.

104. Myoclonus and Delirium Induced by Gabapentin Overdose and Subsequent Withdrawal Associated with Acute Kidney Injury

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Background: Gabapentin is a commonly prescribed drug in the USA. It is often used off-label for the treatment of both psychiatric and pain disorders. Initially few CNS side effects were reported during premarketing studies. In this case, we describe myoclonus and delirium with gabapentin use and discontinuation and its association with acute kidney injury.
Hypothesis: There have been several case reports in the literature describing the potential effects of overdose and withdrawal from gabapentin, but none including myoclonus and delirium in the same course.
Methods: Single-patient chart review.
Case: A 70-year-old male presented to our emergency department complaining of worsening tremors and difficulty voiding. On initial presentation, his vitals were within normal limits. He was alert and oriented, but was tremulous and ataxic. His medications included alprazolam, amitriptyline, and gabapentin. A CT brain was unremarkable. Initial blood tests revealed a creatinine of 4.1 mg/dL and serum creatinine phosphate kinase of 1611 U/L. His creatinine improved to 1.7 mg/dL with hydration, but there was no change in his myoclonus. Neurology's impression was gabapentin overdose and recommended its discontinuation. On day 3 the creatinine normalized, and his myoclonus abated. He was able to urinate and ambulate. That afternoon he was found delirious. At this point Toxicology recommended gabapentin taper. After 1 day, his delirium resolved and patient was discharged home.
Discussion: Gabapentin toxicity can be seen in those with renal dysfunction, even without overdosing. Appropriate management of this would be a cautiously tapering of the medication instead of abrupt discontinuation. This approach will prevent withdrawal symptoms. There is also a concern for gabapentin's role in his urinary retention, considering after it resolved after discontinuation, and has been reported previously.
Conclusion: Gabapentin is a commonly prescribed drug and side effects can be underestimated. As demand for gabapentin use increases, physicians should be aware of CNS side effects, especially in the setting of renal insufficiency. They should also know how to properly manage these scenarios, including the prevention of withdrawal from this medication overdose.

105. Clozapine Increases the Incidence of Pneumonia Compared to Risperidone and to No Antipsychotic Medication in the General Hospital Population

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Background: Clozapine demonstrates superior efficacy in certain severe major mental illness conditions, but it comes with a comparatively heavy burden of toxicity. In addition to receptor-based side effects and metabolic derangements, clinical experience in hospital psychiatry suggests that clozapine therapy may be associated with acute lung infections.
Research Question: To determine whether the incidence of pneumonia in patients taking clozapine was more frequent compared to those taking risperidone or no atypical antipsychotics at all prior to admission to a tertiary care medical center.
Methods: This is a retrospective, case-matched study of 465 general medicine patients over a 25-month period from July 1, 2010 to July 31, 2012. Detailed electronic medical records were analyzed to explore the association between the use of two atypical antipsychotics and incidence of pneumonia. Keyword searches of pharmacy records identified patients taking antipsychotic medications and these patients' hospital admissions were searched by diagnosis for incidence of pneumonia. Fisher's exact test was used for comparing baseline patient characteristics. To quantify the relationship between incidence of pneumonia and use of antipsychotic medications compared to non-use, IBM SPSS, Version 22.0, was employed to calculate odds ratios with 95% confidence intervals.
Results: Of the 155 patients in the clozapine group, 54 (34.8%) had documented pneumonia compared to 22 (14.2%) in the risperidone group and 18 (11.6%) in the general population group. Clozapine, when compared to the untreated general population, was associated with increased risk of pneumonia (OR, 4.07; 95% CI, 2.25–7.36; $p < 0.0001$). There was, however, no significant increase in the risk of pneumonia associated with the use of risperidone (OR, 1.26; 95%

CI, 0.65–2.45). A minimum of 17 (31.5%) of the pneumonias in clozapine patients were attributed to aspiration.
Discussion: Clozapine use is associated with increased risk of pneumonia that may be related to immunologic factors or side effects of sedation, drooling, and extrapyramidal motor problems that make aspiration more likely, although causative mechanisms require further investigation.
Conclusion: Prescribers should use added caution in choosing candidates for clozapine therapy and reassess the balance of clinical benefits against risks of medication toxicity and lung infection over time.

106. Botulinum Antitoxin Administration After Injection of RimabotulinumtoxinB

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Background: Botulism results from exposure to botulinum neurotoxin (BoNT) produced by *Clostridium botulinum*, resulting in significant muscle weakness due to inference of synaptic acetylcholine release. The majority of adult cases are food-borne, but the use of BoNT has resulted in iatrogenic cases of botulism. In 2000, rimabotulinumtoxinB became the only type-B BoNT approved for use in cervical dystonia. However, postmarketing reports have raised concerns regarding the development of systemic manifestations that may last for weeks.
Methods: Single-patient chart review.
Case: A 31-year-old female with a history of cervical dystonia presented with episodic dyspnea and vision changes. She had received a rimabotulinumtoxinB injection 2 weeks prior and subsequently noted intermittent headache, lightheadedness, dry mouth, and constipation. She eventually developed dysphagia and blurry vision without diplopia. She denied eating homemade canned goods and similar symptoms were absent in her partner. On arrival, the patient's vitals were normal. Her exam was notable for mydriasis, ptosis, mild dysarthria, dry mucous membranes and weakness of neck flexion and extension. An initial negative inspiratory force was − 30 cm H_2O. She was admitted for monitoring and botulinum antitoxin was administered within 8 h of her stay, after release by the CDC. Autoimmune testing was negative, and electromyography revealed normal amplitudes and frequency stimulation findings inconsistent with systemic toxicity. However, mouse bioassay testing of her blood was positive for type-B toxin with negative stool samples. She did not develop respiratory failure during the hospitalization but underwent gastrostomy tube placement for dysphagia and poor oral intake.
Discussion: Iatrogenic botulism is rare, but symptoms are similar to those in non-iatrogenic cases. Injections of BoNT have resulted in rare cases of botulism treated with antitoxin. However, the efficacy of antitoxin, especially when symptoms are delayed, is unclear. Resultant morbidity and healthcare burden can be significant.
Conclusion: There is a paucity of research describing local symptoms versus systemic effects in iatrogenic botulism. It appears that BoNT products may spread from the area of injection to produce systemic effects. There are few published reports of antitoxin administration in the treatment of iatrogenic botulism and a standardized approach is lacking.

107. Serotonin Toxicity Case Characteristics and Associated Xenobiotics: a Review of the Toxicology Investigators Consortium (ToxIC) Database

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Background: Serotonin toxicity is a common cause of drug-induced altered mental status. However, there are no large case series evaluating the causes of serotonin toxicity, describing the symptomatology, or rate of treatment with antidotal therapy.
Research question: What are the patient characteristics and xenobiotics associated with the development of serotonin toxicity?
Methods: This study evaluated cases of serotonin toxicity in the ToxIC registry, a national database of prospectively collected cases seen at the bedside by medical toxicologists from > 50 geographically diverse sites that contains over 50,000 cases. The database was searched for "serotonin syndrome" between 1/1/2010–12/31/2016. Cases were excluded if multiple toxidromes were listed or if marked as "unlikely tox related" or "unknown if tox related." Descriptive statistics were used to summarize demographics, signs/symptoms, outcomes, and associated xenobiotics.
Results: Included were 1010 cases. Females made up 608 cases (60%). Ages: < 2 (3, 0.3%), 2–6 (8, 0.8%), 7–12 (9, 0.9%), 13–18 (278, 27.3%), 19–65 (682, 67%), and > 66 (35, 3.4%). Reasons for encounter: drug abuse (53, 5%), intentional (789, 78%), adverse drug event (95, 9%), and unintentional (66, 6%). Signs and symptoms: hyperreflexia/clonus/myoclonus (601, 60%), agitation (337, 33%), tachycardia [HR > 140 bpm] (256, 25%), rigidity (140, 14%), seizures (139, 14%), hypertension [SBP > 200 mmHg; DBP >120 mmHg] (71, 7%), and hyperthermia [T > 105 F] (29, 3%). Complications: rhabdomyolysis (97, 10%), ventricular dysrhythmias (8, 0.8%), and death (1, 0.1%). Treatments: benzodiazepines 67% (677/1010) and cyproheptadine 15%(153/1010). One hundred ninety-two different xenobiotics were reported with 2046 total exposures. Antidepressants as a class were most commonly the 'primary agent' listed (915, 45%) with bupropion the most frequent overall (147, 7.2%). Common non-antidepressants were dextromethorphan (95, 6.9%), lamotrigine (64, 3.1%), and tramadol (60, 2.9%).
Discussion: In this series, serotonin toxicity most often occurred in adult patients with intentional overdose. Antidepressants were most often listed as the primary agents of toxicity. Interestingly, bupropion, a norepinephrine/dopamine reuptake inhibitor, was the most frequently mentioned xenobiotic. Benzodiazepines were commonly administered. Though often cited as a potential antidote, only 15% of patients received cyproheptadine. Severe toxicity was rare. Only a single death was reported.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

108. Protein Powder Paroxysms: Severe Strychnine Toxicity After Intentional Product Tampering

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Background: Strychnine is derived from the *Strychnos nux-vomica* tree. While it has been used for centuries for a variety of medicinal purposes and has been implicated in many famous or dramatic historic poisonings, poisoning is rare in modern times. Its use is now restricted to rodenticides and glycine receptor research. Strychnine competitively antagonizes glycine at postsynaptic glycine chloride channels, resulting in loss of inhibition of the reflex arc. This causes uncontrolled muscular contractions with resultant hypoventilation, acidosis, rhabdomyolysis, and multi-organ failure.
Methods: Single-patient chart review.
Case: A young, healthy adult female developed muscle spasms in her legs 15 min after ingesting a protein shake made from commercial protein powder. A friend who was with her immediately called EMS. She had another episode of spasms, became apneic, and lost pulses. CPR was performed for

2 min with return of spontaneous circulation. On arrival to the hospital, vitals were T 36.6 °C, HR 134 bpm, BP 198/123 mmHg, RR 30 bpm, SpO2 96%. She continued to have episodes of painful contractions of the upper and lower extremities brought on by minimal stimulation along with hypoventilation and hypoxia. Her mental status remained preserved throughout. Laboratory results were pH 6.80, pCO_2 80 mmHg, lactate 28.1 mmol/L, serum HCO_3 9 mEq/L, creatinine 1.3 mg/dL, glucose 171 mg/dL, creatine kinase 123 U/L. EKG showed sinus tachycardia. Spasms improved with IV lorazepam. Despite treatment, she had further severe episodes with apnea and hypoxia requiring intubation. She was sedated with propofol and extubated after 24 h. She received one additional dose of lorazepam after extubation and was discharged after 72 h. Plasma strychnine concentration 3 h after ingestion was 680 ng/mL and an expanded drug screening detected caffeine and cannabinoids.
Discussion: This patient developed severe strychnine toxicity with acidosis, hypoxia, and hypoventilation. The strychnine concentration was consistent with prior reports of severe strychnine poisoning. Propofol, which has glycine agonist properties, was sufficient for treatment without need for additional neuromuscular blockade. In collaboration with the health department and law enforcement, it was determined the product did contain strychnine and had been deliberately contaminated aftermarket. A criminal case is pending.

109. Unintentional and Sequential Lead Exposure from Hot Lemon Water and Maca (*Lepidium meyenii*)

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Introduction: Although the incidence of lead poisoning has decreased in the United States over the last 30 years, human exposures to lead containing products are still reported. We present a case of unintentional lead exposure from a beverage and a nutritional supplement.
Methods: Single-patient chart review.
Case: A 32-year-old female was found to have a whole blood lead concentration of 44 mcg/dL. Evaluation of her home, occupation, and hobbies initially did not identify a source of lead exposure. Further investigation revealed that hot lemon water, ingested from an older ceramic mug while she was pregnant, was the likely etiology of her exposure. She stopped drinking the water and her blood lead levels decreased. Due to the patient's desire to become pregnant again, she continued to follow-up in the Medical Toxicology clinic and had serial blood lead testing performed. A year after her initial diagnosis, she began to ingest maca root powder as a nutritional supplement, and her blood lead levels increased again. Upon discontinuation of maca root powder ingestion, her blood lead levels decreased further.
Discussion: Over time, the acidity and heat of the hot lemon water used in the ceramic mug enhanced the breakdown of its leaded glaze. Maca root powder, which is available as a nutritional supplement and is used to treat fatigue and enhance fertility, may contain lead and other minerals.
Conclusion: The use of maca root powder as a dietary supplement and hot lemon water ingested from an old ceramic mug represent two novel routes of lead exposure. In cases where the source of lead exposure is unknown, thorough evaluations of occupational, residential, and dietary practices may result in enhanced identification of the source(s) of exposure. Consumers, particularly women of childbearing age, and their physicians should be aware that imported products available from commercial retailers and internet vendors may contain significant amounts of lead.

110. Early Administration of *N*-Acetylcysteine in the Treatment of Clove Oil Ingestion

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Background: Ingestion of clove oil, an essential oil derived from the clove plant (*syzygium atromaticum*), has been reported as a rare cause of hepatotoxicity from its major component eugenol. Data from animal models suggests glutathione depletion to be a necessary precursor to eugenol-induced liver injury.
Hypothesis: Early treatment of clove oil ingestion with n-acetylcysteine results in decreased hepatotoxicity.
Methods: Single-patient chart review.
Case: We report a case of a previously healthy 3-year-old child who ingested an unknown quantity of clove oil which was being used in his home as a dental analgesic. He presented to a hospital with lethargy, ataxia, and vomiting. His initial laboratory studies were unremarkable. Following transfer to a tertiary facility, repeat laboratory studies were drawn and showed mildly elevated transaminases (AST 266 IU/L, normal 25–55 IU/L; ALT 164 IU/L, normal 17–63 IU/L). At 7 h post-ingestion, *N*-acetylcysteine therapy was started. During the patient's course, he continued to exhibit encephalopathy and further laboratory abnormalities which included a peak AST and ALT of 7526 and 6494 IU/L, respectively. However, his clinical course resolved on day four without any other significant complications.
Discussion: Clove oil ingestion has been treated previously with the antidotal therapy *N*-acetylcysteine that replenishes hepatic glutathione reserves. In prior cases of eugenol poisoning, *N*-acetylcysteine was administered 24 h or longer following ingestion of clove oil where prolonged hepatotoxicity, acidosis and uremia occurred in spite of therapy. In our case, wherein *N*-acetylcysteine was given only 7 h following ingestion, the patient did not develop acidosis, hypotension, coagulopathy, or other more severe manifestations of eugenol poisoning where treatment with *N*-acetylcysteine was delayed or not given. In acetaminophen toxicity, which is also predicated on glutathione depletion, earlier administration of *N*-acetylcysteine has also been associated with better outcomes.
Conclusion: Early administration of *N*-acetylcysteine in cases of eugenol poisoning may result in better outcomes and should be considered.

111. Unintentional Melanotan II Overdose Causing Sympathomimetic Symptoms

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Background: Melanotan II is a synthetic analogue of melanocortin used by body builders for the cosmetic purpose of tanning as well as an aphrodisiac. We present a case of an unintentional Melanotan II overdose resulting in sympathomimetic toxicity.
Methods: Single-patient chart review.
Case: A 49-year-old male with a history of hypertension, hyperlipidemia and depression presented to the Emergency Department after subcutaneously injecting himself with 5 mg of Melanotan II; ten times the intended dose of 500 mcg. The patient bought the supplement online to cosmetically darken his skin. One hour after injection, the patient reported multiple episodes of vomiting, tremors, and an erection. Initial vitals were blood pressure 158/77 mmHg, heart rate 85 bpm, respiratory rate 19 bpm, oxygen saturation 97%, and temperature 98.6 °F. On exam, the patient was anxious, diaphoretic, tremulous, with dilated pupils, and had a semi-erect penis. The remainder of his exam was unremarkable. Laboratory analysis was significant for a CK of 700 U/L. The patient was treated with benzodiazepines, antiemetics, and intravenous fluids. The next day, the patient had full resolution of symptoms, but his repeat CK increased to 1785 U/L. This value was unchanged 5 h later and the patient was discharged home with primary care follow-up.
Discussion: Synthetic melanocortin analogues, such as Melanotan II, are unlicensed supplements that are largely marketed online to aid in skin tanning and improve sexual functioning. They are based on their endogenous

counterparts, melanocortin peptides, that play a role in sexual functioning and pigmentation. Patients have been using these unlicensed supplements but are unaware of the toxicities associated with them. We present a case of an unintentional overdose that resembles a sympathomimetic toxidrome causing considerable discomfort to the patient. There is scant literature to describe the toxicity associated with use of this supplement.
Conclusion: Patients should be advised of the risks of toxicity from unregulated, non-prescription supplements. Further studies are necessary to determine the potential toxicity of these exposures.

112. Phenibut Toxicity from a Nutritional Supplement: a Recreational Misadventure Requiring Intubation

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Background: Phenibut (beta-phenyl-GABA) is a GABA-agonist that can be legally obtained as a nutritional supplement. Typically marketed as an anxiolytic and nootropic, it is thought to exert its effect predominantly on GABA-B receptors. Phenibut exposures have been increasingly reported to poison control centers and frequently require airway support. We describe a case of a 54-year-old woman who developed < 16 h of profound sedation with loss of airway reflexes after an intentional phenibut overdose.
Methods: Single-patient chart review.
Case: A 54-year-old female with depression and prior suicide attempts presented to the ED < 6 h after ingesting an unknown quantity of "white powder," later identified as phenibut. The family called EMS after the patient exhibited 2 h of progressive CNS depression that culminated in unresponsiveness. Vital signs upon ED arrival were: BP 150 s/90s mmHg; HR 40–60 bpm; RR 5–8 bpm; Temp 34.6 °C, O_2 Sat 95–100%. Physical exam was remarkable for an obtunded adult female, GCS 8, symmetric reactive pupils (4 mm), bradypnea, bradycardia, hypothermia, and an absent gag reflex. Labs were remarkable only for a venous blood gas that showed pH 7.28, PCO_2 54 mmHg, and bicarbonate 22 mEq/L. ECG was remarkable for sinus bradycardia with first-degree AV block. She did not respond to 0.4 mg IV naloxone and was intubated for airway protection. Sedation was not required initially, but propofol was started roughly 8 h after intubation to control her agitation. She was extubated < 12 h after ED arrival, at which time she was neurologically intact and endorsed consuming the phenibut in an attempt to quell her anxiety. She obtained the product by confiscating it from her daughter who had in turn procured it via the internet for recreational abuse. The actual product was clearly labeled as "Phenibut," claiming that it "Improves cognitive function." The patient's whole blood phenibut level was > 50,000 ng/mL.
Discussion: We describe a case of phenibut intoxication with the highest drug level ever reported. Health care providers should be aware of phenibut's existence as a potent sedative-hypnotic that can be obtained with ease and abused as a "legal high."

113. Redotex: The Mexican Diet Pill That Is Not What It Claims to Be

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Background: Redotex® is a weight loss supplement available from Mexico which reportedly contains a mixture of triiodothyronine (75 mcg), norpseudoephedrine (50 mg), atropine (0.36 mg), aloin (16.2 mg), and diazepam (8 mg). It was banned by the FDA in 1987, but there have been 184 seizures at the USA border since 2007. There is little reported in the literature about Redotex® and no literature regarding the contents of Redotex® pills.
Research question: Does the content of Redotex® capsules match what is listed on the label?
Methods: Single-patient chart review.
Case: A two-year-old patient with no past medical history, no home medications, and no contributing family history was found with an open bottle of Redotex® and had partially ingested a pill. He received 18 g of activated charcoal upon arrival to the emergency department and was discharged after 6 h of observation with no abnormal vital signs or symptoms of ingestion. Three Redotex® pills from the bottle were analyzed using solid phase extraction and analysis by GC/MS and LC/MS. Pill analysis revealed that the capsules contained norpseudoephedrine 50 mg, diazepam 10 mg, and atropine 1 mg. Aloin and triiodothyronine are not present in the targeted library and were not analyzed.
Discussion: Our analysis revealed that the pills contained approximately 25% more diazepam and approximately 270% more atropine than what was listed on the label. While our patient did not have any adverse effects from his Redotex® exposure, pill analysis revealed a potentially dangerous combination of medication that differed from what was reported on the label. Our study is limited due to analysis of a small sample from a single bottle. Aloin and triiodothyronine levels remain unknown since they were not analyzed.
Conclusion: Redotex® may contain a potentially dangerous combination of substances in amounts that do not correspond with what is reported on the label.

114. Accidental *Datura stramonium* Poisoning after Ingestion of a Local Leafy Vegetable Salad in Lebanon

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Background: *Datura stramonium*, known as Jimsonweed, is a plant in the nightshade family. All parts of the plant contain toxic levels of the tropane anticholinergic alkaloids atropine, hyoscyamine, and scopolamine.
Hypothesis: Anticholinergic syndrome can result from ingestion of a salad contaminated with *D. stramonium*.
Methods: Single-family case series.
Results: A family of four presented to an ED in Lebanon, 2 h after sharing a salad made of a local leafy vegetable known as Khubaiza (*Malva sylvestris*). The first patient (43-year-old male) presented with disorientation, aggressive behavior, dry hot skin, flushed face, dilated pupils and urinary retention. The second patient (12-year-old girl) presented with bizarre behavior, disorientation, hot dry skin, dilated pupils and urinary retention. The third patient (73-year- old female) presented with dizziness and history of disorientation earlier. She had a dry hot skin, dilated pupils and urinary retention. The fourth patient (48-year-old female) was alert, oriented and conscious. She complained of nausea and had dilated pupils. The patients received supportive care including benzodiazepines. Salad samples were sent to a botanist for identification. The salad was composed of leaves of *Malva sylvestris* mixed with *D. stramonium*. The first patient was admitted to the hospital for observation and discharged after 1 day. The second patient was admitted for 24 h observation. The third and fourth patients were observed in the ED for 6 h. All four patients were free of symptoms after 3 days.
Discussion: Mixing by local farmers of leafy vegetables with toxic materials is not uncommon. This can happen due to contamination or fraud.
Conclusion: Sample identification through consultation with a plant expert can be crucial to confirm diagnosis after symptomatic plant ingestion.

115. A Case of Acute Abrin Toxicity via Ingestion and Inhalation Confirmed by Multiple Urine L-Abrine Levels

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Background: Abrin is one of the most deadly plant toxins and inhibits protein synthesis. We present the first reported case of human toxicity from both an inhalational route and confirmed with multiple urine L-abrine levels.
Methods: Single-patient chart review.
Case: A 46-year-old female with history of depression, anxiety, PTSD, and migraines presented to the emergency department requesting comfort care after what she presumed to be a lethal overdose. She crushed 20 *Abrus precatorius* seeds purchased off the internet and mixed half with water for ingestion and insufflated the other half. She presented 8 h post ingestion with nausea, multiple episodes of severe vomiting, and abdominal pain. Her initial vital signs were stable. Her physical exam was unremarkable including clear lungs to auscultation and a soft abdomen with voluntary guarding. She was admitted to the intensive care unit for close monitoring for 72 h. Her symptoms resolved throughout her hospital stay with full recovery. Laboratory evaluation included CBC, CMP, VBG, lactate, and toxicology screens. Abnormal findings included WBC of 13.0×10^9/L, platelets of 454×10^9/L, alkaline phosphatase of 203 IU/L, bicarb of 18.5 mEq/L, venous pH of 7.46 with pCO_2 of 26.3 tor. Her chest x-ray showed no acute disease and her electrocardiogram was normal. Urine samples obtained about 13, 22.5, and 38.5 h post exposure were sent to a state lab for testing and showed L-abrine levels of 397 ng/ml, 9.26 ng/ml, and a non-detectable level respectively.
Discussion: Abrin is the toxic component of *Abrus precatorius* seeds with a lethal dose of 0.1–1 mcg/kg. L-Abrine is a nontoxic component that can be quantified to confirm exposure. Oral absorption of abrin is limited by both incomplete breakdown and partial digestion of the protein. Despite ingesting and inhaling lethal amounts of abrin our patient did well with supportive care.
Conclusion: Abrin exposure can be lethal and early recognition is key as it does not show up on routine drug screens but can be confirmed with urine L-abrine early after exposure.

116. Chicken of the Woods: *Laetiporus sulphureus* Exposures Reported to US Poison Control Centers: An NPDS Study

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Background: *Laetiporus sulphureus* is an Agaricomycetes mushroom frequently referred to by its common name "Chicken of the woods" due to its distinctive flavor and texture. A single case report from 1988 associated consumption with hallucinations and ataxia in a 6-year-old child. *L. sulphureus* has not been demonstrated to contain psilocybin or other known hallucinogens but is classified as a "Group 6 Mushrooms: Hallucinogenics (Psilocybin and Psilocin)" in Micromedex.
Research Question: We sought to characterize *L. sulphureus* exposures reported to the NPDS database and to determine the incidence of reported hallucinations or ataxia.
Methods: All single-substance human exposures to Group 6 Mushrooms: Hallucinogenics (Generic Code 058000) from 2000 to 2015 were identified in the NPDS database. Exposures to *L. sulphureus* were identified as a subset using its product code 4191469. Non-ingestion routes were excluded. Data was analyzed using Excel and descriptive statistics were used to summarize the data. Clinical effects coded as "related" or "unknown if related" were considered to be present. The primary outcome was the incidence of hallucinations or ataxia. The subset of followed cases was analyzed for the incidence of moderate and major outcomes.
Results: All cases of *L. sulphureus* in the NPDS dataset were included in this subset. A total of 113 of 114 exposures to *L. sulphureus* were ingestions and one inhalation case was excluded. Monthly exposures peak in October and annual exposures peak in 2014. Clinical effects were predominantly gastrointestinal. Abdominal pain, nausea, vomiting, or diarrhea was reported in 71 of 113 cases. Hallucinations and ataxia were not coded in any case. The 73 known outcomes were overall mild with only nine moderate effects; no deaths or major effects were coded.
Discussion: *L. sulphureus* has a reputation for being an edible mushroom despite previously reported hallucinations and ataxia. No cases associated with these clinical effects were identified nor were further examples found in the literature. Exposures appear relatively benign but have the potential for gastrointestinal effects.
Conclusion: *L. sulphureus* ingestions appear benign. Its inclusion within the generic code for hallucinogenic mushrooms appears unwarranted. When reviewing NPDS data one should also consider product code names.

117. Monomethylhydrazine (MMH)-Containing Mushroom Exposures: US National Poison Data System

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Background: There are several species of monomethylhydrazine-containing mushrooms in the United States, of note *Gyromitra californica*, *Gyromitra esculenta*, *Gyromitra gigas*, and *Gyromitra infula*. Current data regarding exposure to *Gyromitra* is limited to case reports and experimental exposure on animal models.
Research Question: What are the demographics, distribution, frequency, and outcomes of exposure to monomethylhydrazine-containing mushrooms in the USA?
Methods: Retrospective review of NPDS monomethylhydrazine-containing mushroom exposures from 2001 to 2011. Descriptive statistics were used to analyze the data.
Results: There were 27 pediatric exposures (≤ 6 years) and 421 cases > 6 years or of unknown age. Two deaths were reported, one via intentional exposure and the other unintentional. Six exposures resulted in a major effect with only one of these cited as an intentional ingestion. Observed effects were none (27%), minor (29%), moderate (15%), major (0.02%), and unknown (29%). Common outcomes were abdominal pain (16%), nausea (24%), and vomiting (32%). Dispositions included: managed on-site (46%) and treated at a health care facility (54%) with a small minority unknown. Compared to other species, *G. californica* ingestions were more likely to have major effects, whereas *G. esculenta* accounted for the majority of intentional ingestions (82%). Intentional ingestions were relatively rare, accounting for 7% of reported exposures. Pediatric exposures accounted for 6% of cases overall, and of those followed, only two (11%) developed moderate symptoms. Exposures were predominantly localized to three regions of the country: Pacific North West, East North Central, and Midwest states.
Discussion: The majority of reported cases are unintentional adult ingestions of *G. esculenta* or *G. gigas* with less than 5% requiring critical care. *G. californica* exposures were relatively rare, although 50% of reported ingestions resulted in death. GI symptoms of abdominal pain, nausea, and vomiting are common after ingestion of *Gyromitra* species. Pediatric exposures were less common and less likely to result in severe symptoms.
Conclusion: Monomethylhydrazine-containing mushroom exposures in adults are more commonly severe, with *G. californica* causing more severe toxicity than *G. esculenta* and *G. gigas*, with data on exposure to *G. infula* limited to one case report.

118. The Forager's Dilemma: A Unique Case Series of an Amatoxin-Exposed Family, Including a Breastfeeding Mother and Infant

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Background: Amatoxin is challenging to treat given its asymptomatic incubation period and lack of consistently efficacious treatment modalities. We report a unique scenario of two cases resulting in clinical hepatotoxicity and one breast milk exposure.
Methods: Chart review of a family exposed to amatoxin.
Results: A 61-year-old Chinese woman foraged mushrooms from Long Island, NY. She developed nausea, vomiting, and diarrhea 11 h post-ingestion and presented to the ED 15 h post-ingestion with stable vitals. Medical toxicology was consulted and she was treated with 0.9% normal saline IV, IV *N*-acetylcysteine, and one million units IV penicillin G. Oral silymarin was considered but not available and activated charcoal was held given vomiting. Initially, creatinine was 0.97 mg/dL, INR 0.95, and AST 33 U/L which increased to 773 U/L. She was transferred to a liver transplant center 56 h post-ingestion where treatment with normal saline and *N*-acetylcysteine continued. AST and INR peaked at 17,470 U/L and 2.7 without creatinine elevation or encephalopathy. Upon discharge 8 days post-ingestion, AST was 75 U/L and INR 1.2. Her 32-year-old daughter-in-law, who shared the meal, developed symptoms 15 h post-ingestion and presented to the ED 29 h post-ingestion with stable vitals. She was provided the same treatment. AST on presentation was 105 U/L and she was transferred to a liver transplant center where AST peaked at 1535 U/L without creatinine/INR elevation or encephalopathy. AST was 187 U/L upon discharge 5 days post-ingestion. Her 4-month-old daughter breastfed 4 h post-ingestion. The asymptomatic infant was evaluated 48 h after breastfeeding and discharged from the ED with AST of 44 U/L. The milk was collected pending analysis of amatoxin. The mushrooms were identified by a mycologist as *Amanita bisporigera*.
Discussion: The treatments for amatoxin are variable with many commonly implemented treatments lacking clinical efficacy. We report two cases with varying toxicity that improved primarily with IV fluids and *N*-acetylcysteine. There is no existing data on analytic sampling of amatoxin breast milk concentrations in current literature. We report a unique scenario of an infant potentially exposed through breast milk that was collected, pending analysis for amatoxin.

Day 3: Platforms, Abstracts 119–122

119. The Use of Mitochondrial-Directed Therapy to Improve Respiration in Blood Cells with In Vitro Exposure to Cyanide

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Background: Cyanide is a mitochondrial inhibitor that causes bioenergetic failure by interfering with cytochrome *c* oxidase (Complex IV) respiration. At this time, treatment that directly supports bioenergetic failure with cyanide is limited.
Objective: The objective of this study is to measure improvement in mitochondrial respiration after treatment with a succinate prodrug (NV118) in human blood cells exposed to cyanide in vitro.
Methods: A venous blood sample was collected from 20 healthy volunteers after informed consent with isolation of peripheral blood mononuclear cells (PBMCs). PBMCs from 10 subjects served as the Control group with the other half of the remaining blood sample incubated with 50 mM of potassium cyanide (KCN) for 5 min serving as the KCN group. After measurement of mitochondrial respiration was obtained, PBMCs were placed in a 2-mL chamber with a concentration of $2–3 \times 10^6$ cells/mL. Measurements of oxygen consumption were performed in a high-resolution oxygraph (OROBOROS Oxygraph-2k). Oxygen flux (in pmol O_2/s/10^6 cells), which is directly proportional to oxygen consumption, was recorded continuously to obtain the following parameters of respiration: Routine (resting state), LEAK (proton leak), ETS (maximal respiration or cell reserve), residual oxygen consumption and CIV respiration. In addition to obtaining baseline respiration in both groups, NV118 (100 uM) was injected and the same parameters of respiration were obtained as a comparison.
Results: There were significant differences in relevant key parameters of mitochondrial respiration: PMBCs in the KCN group had overall significantly lower respiration compared to the Control group ($P < 0.0001$). There was a significant increase in respiration with NV118, specifically with an increase in ETS-, CII-, and CIV-linked respiration in both groups ($P < 0.0001$).
Discussion: PBMCs from the KCN and Control group differed in both routine and ETS respiration. PBMCs from both groups demonstrated increased CII-linked activity, ETS and CIV respiration with NV118. The KCN group treated with NV118 demonstrated increased respiration that was similar to the Control group demonstrating effect of NV118.
Conclusions: Our results suggest that the NV118 increases CII respiration to improve CIV respiration in human blood cells exposed to cyanide.

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120. Adverse Drug Events and Reactions Managed by Medical Toxicologists: an Analysis of the Toxicology Investigators Consortium (ToxIC) Registry, 2010–2016

Gillian Beauchamp[1,2], Marna Rayl Greenberg[1], Matthew Meyers[3], Matthew Cook[1,2], Robert Cannon[1,2], Kenneth Katz[1,2], Alexandra Amaducci[1], Yaron Finkelstein[4,5], On behalf of the Toxicology Investigators Consortium (ToxIC)[6]
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Background: Adverse drug events/reactions (ADE/ADR) cost more than $75 billion annually and are among the leading causes of death in the USA. Little is known about patients treated at the bedside for ADE/ADR by medical toxicologists.
Hypothesis: The aim of this study is to review ADE/ADRs reported to the ToxIC registry.
Methods: We reviewed all cases cataloged in ToxIC registry between 1/2010–12/2016. Age was categorized as pediatric (0–18 years), adult (19–65 years) and older adult (> 65 years). Descriptive statistics were used to analyze study variables as appropriate. Chi-square tests and logistic regression were used to assess differences in distribution of study variables by participant age and sex. All analyses were performed with Stata SE v 14.2.
Results: A total of 50,899 patients were identified in the registry: 13,836 (27.2%) were pediatric, 34,133 (67.1%) were adults and 2930 (5.8%) were older adults. ADE/ADRs accounted for 1840 cases, 3.6% of all consults to medical toxicologists. Compared to the 19–65 age group, older adults were more likely to be managed for an ADE/ADR (OR = 4.2, 95% CI: 3.7–4.7). There was a trend for female predominance of ADE/ADR with prevalence in females and males 3.8 and 3.5%, respectively (NS). The most common class of drug associated with ADE/ADRs in the pediatric population was antipsychotics (18.1%); for adults, opioids/analgesics (12.4%); and for older adults, cardiovascular medications (32.1%). Bradycardia was the most reported vital sign abnormality, occurring in 13.2% of the sample, and was more common (OR = 4.9, 95% CI: 3.1–7.7) in older adults compared to younger adults. For ADE/ADRs, the most common medical interventions were "none/observation" (73.2%), pharmaceutical (21.9%) and intubation (5.0%), with no differences by patient sex.

Discussion: Age-based differences were observed in agents involved in ADE/ADRs: antipsychotics among children, opioids/analgesics among adults up to age 65 and cardiovascular medications among older adults. These differences have potential implications for age-specific prevention and management strategies of ADE/ADRs.
Conclusion: Age-based differences were observed among patients managed at the bedside by medical toxicologists for ADE/ADRs, with a strong predominance among older adults.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

121. Pharmacotherapy of Induced Heat Stroke/Hypermetabolic Crisis in an Anesthetized Swine Model

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Background: Exertional heat stroke (EHS) is a rare, unpredictable, and often fatal condition without an approved pharmacotherapy. A reliable animal model of induced heat stroke/hypermetabolic crisis (HS/HC) was used to study a potentially efficacious pharmacotherapy for human EHS.
Hypothesis: Bolus IV injection of dantrolene sodium nanosuspension 250 mg/5 mL (DSN), in conjunction with standard therapy (ST, external cooling), is superior to ST alone.
Methods: A randomized, blinded, controlled study was conducted in malignant hyperthermia susceptible (MHS) swine. MHS swine exhibit HS/HC in response to heating that mimics the HS/HC crisis in EHS-affected humans. HS/HC was induced by treadmill exercise in conscious MHS swine (in an earlier study) or through passive heating of anesthetized MHS swine. At protocol-defined HS/HC onset, subjects received either DSN and ST or ST only. The primary efficacy endpoint was reversal of HS/HC, defined as return of end-tidal CO_2 ($ETCO_2$) to ± 10% of baseline, absence of muscle rigidity and arrhythmias, and either return of core body temperature to ≤ 1 °C above baseline or body temperature < 39.8 °C that was stable or declining. Additional endpoints included improvements in pO_2, pH, heart rate and electrolyte levels. Results: 9.1% (1/11) subjects treated with ST alone achieved HS/HC reversal versus 58.3% (7/12) treated with DSN plus ST. This difference was robust and statistically significant in favor of DSN plus ST (p = 0.0272). Additionally, time to HS/HC reversal was significantly shorter for animals treated with DSN plus SN (p = 0.0232).
Discussion: The robust, increased incidence for HS/HC reversal, along with shorter time to reversal, is clinically meaningful endpoints. HS/HC exhibited by MHS swine in response to certain anesthetics, active and passive cooling, and psychostimulant overdose mimic HS/HC in humans in response to these same stimuli.
Conclusion: There was a robust, statistically significant and clinically meaningful treatment difference in favor of DSN plus ST as compared with ST alone in the treatment of HS/HC. These study results provide strong support for the efficacy of DSN plus ST as life-saving treatment for EHS in humans.

122. Bioequivalence of Tenofovir Diphosphate in Digital Pills

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Background: Digital pills, gelatin capsules with radiofrequency transmitters activated by stomach chloride ions, over encapsulate and directly measure medication adherence. In individuals with substance use disorders and HIV, real-time nonadherence detected by digital pills creates a novel space to develop substance use and adherence skill interventions to promoting sobriety and encourage engagement with care. In this study, we determined the bioequivalence of tenofovir diphosphate (TDF) in healthy human volunteers with and without digital pills.
Hypothesis: The release and absorption of TDF from digital pills is bioequivalent to TDF alone.
Methods: This study adhered to the US FDA Analytical Procedures and Methods for Validation for Drugs and Biologics guidelines. Five healthy volunteers were recruited through advertisements. Participants > 18 years, nonpregnant, HIV negative, and without reported allergy to tenofovir, emitricitabine or ripilivirine were enrolled in the study. Participants presented to our center for clinical investigation after fasting overnight; provided written informed consent, received a meal of at least 400 cal and 10 g fat, and ingested a digital pill containing tenofovir/emitricitabine/ripilivirine (Complera). Peripheral venous blood samples were collected at 0.5, 1, 2, 4, 8, and 24 h post ingestion. After a 14-day washout period, participants returned to the CCI and ingested Complera without the digital pill. Serial venous blood samples were collected using the similar protocol to ingestion of the digital pill. Liquid chromatography/mass spectroscopy (LC/MS) was used to determine a maximum concentration (Cmax) and area under curve (AUC) of TDF in comparison to the commercially available TDF standard.
Results: Five participants completed the study. Mean age was 27; 20% (N = 1) were male; 80% (N = 4) were female. Cmax and AUC (mean [95%CI]) of TDF in participants ingesting Complera digital pills was 4.37 [4.17–4.56] and 6.64 [6.29–6.98]. In participants ingesting Complera alone, Cmax and AUC of TDF were 4.42 [4.22–4.61] and 6.45 [6.11–6.79]. The differences are not statistically different with p-values of 0.083 and 0.369, respectively.
Discussion: Our data indicate that digital pills have no effect on the bioequivalence of TDF. These preliminary data suggest investigators can use digital pills containing TDF to measure adherence without compromising TDF absorption and dosing.

Day 3: Moderated Posters, Abstracts 123–128

123. Sex Differences in Adult Abuse and Misuse Cases: an Analysis of the Toxicology Investigators Consortium (ToxIC) Registry: 2010–2016.

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Background: Sex differences have been previously reported in classes of abused drugs.
Hypothesis: The aim of this study is to review poisonings in adults presenting with drug abuse/misuse as managed by bedside medical toxicologists.
Methods: ToxIC cases ages 19–65 years with drug abuse or misuse between 1/2010–12/2016 were included. Descriptive statistics, chi-square tests, and logistic regression were used to assess differences in distribution of study variables by sex. All analyses were performed with Stata SEv14.2.

Results: Among 51,441 total registry cases, 542 (1.05%) were excluded for missing data: 34,133 cases were ages 19–65 years, among which 3426 (10.0%) were included for misuse/abuse. 47.5% were white, 12.6% black, 0.6% Asian, 6.2% other, 32.9% race unknown. Racial distributions were similar by sex. Overall, 52.9% of cases were pharmaceuticals. Females were more likely to present with pharmaceutical exposure than non-pharmaceutical exposure (OR = 2.3, 95% CI1.9–2.6). Males were more likely than females to present with non-pharmaceutical exposure (54.1 versus 34.2%, $p < 0.001$). Opioids/analgesics accounted for 34.0% of cases with females having a higher proportion of opioids/analgesics cases than males (37.9 versus 28.7%, $p < 0.001$). The second most common was anti-depressants at 15.4% of cases, with no difference observed between sexes (14.5 versus 16.0%, NS). Females were more likely to present for opioids than males (OR = 1.7, 95% CI 1.4–1.9), whereas males were more likely to present for sympathomimetics (OR = 1.5, 95% CI 1.2–1.8) and psychoactives (OR = 3.0, 95% CI 2.3–4.0). 6.1% of patients had a vital sign abnormality, with tachycardia most common (9.0%). Most common interventions were pharmaceutical support (males = 29.9%, females = 23.0%, $p < 0.001$) and intubation (males = 14.0%, females = 12.0%, NS). Death was reported in 1.4% ($n = 47$) of cases of misuse/abuse, representing 12.8% of the 184 females + 183 males who died among all registry cases in this age group.
Discussion: Among adults with drug misuse/abuse, females were more likely to have used an opioid pharmaceutical and males were more likely to have used a non-pharmaceutical sympathomimetic or psychoactive agent.
Conclusion: Sex differences were observed among adult patients managed for drug abuse or misuse, which may have implications for both management and prevention.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

124. Association Between Initial Platelet Count and Antivenom Dose Following Rattlesnake Envenomation

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Background: Venom-induced thrombocytopenia may occur following rattlesnake envenomation (RSE). Association between initial platelet count and dose of antivenom administered has not been studied.
Research Question: Does severity of thrombocytopenia prior to antivenom affect outcomes in RSE?
Methods: Prospective review of RSE patients entered into the ACMT North American Snakebite Registry (NASBR) between 2013 and 2016, with cases excluded if platelets were never reported or Fab antivenom was not used. Patients were grouped by degree of thrombocytopenia before antivenom: severe (platelets 0–50 K/mm^3), moderate (platelets 51–120 K/mm^3), or normal (platelets ≥121 K/mm^3). Data extracted included demographics; initial, nadir, discharge, and follow-up platelets; initial and total antivenom dose. Descriptive statistics including median (IQR) and univariate analysis were used with linear regression to determine independent predictors of total vials administered.
Results: Three hundred fifteen patients were included, 296 with pre-antivenom platelet count available. Most were from AZ, CA, and UT. Median age was 38 years (19.8, 57); 75% men; 51% upper extremity bites. Median initial platelets = 222 K/mm^3 (171, 273); median time to antivenom = 2.5 h (2,4); median initial antivenom dose = 6 vials (4,6); and median total antivenom dose = 10 vials (6,16). 'Severe' $n = 13$ patients; 'moderate' $n = 25$ patients; and 'normal' $n = 258$ patients. Platelet group predicted total vials of antivenom administered ($p = 0.027$), with lower platelets associated with higher total vials. Other independent predictors of total vials were initial vials ($p < 0.001$) and time to antivenom ($p = 0.001$). Time to antivenom was inversely related to total vials, with later presentation associated with lower dose. One hundred forty-nine patients had follow-up platelets available; 24/37 patients (65%) with initial, nadir, or discharge platelets ≤ 120 K/mm^3 developed recurrent thrombocytopenia, while 27/112 patients (24%) with nadir platelets > 120 K/mm^3 developed new, delayed-onset thrombocytopenia.
Discussion: Venom-induced thrombocytopenia is sometimes used as a marker of severity in RSE, which can affect antivenom dose administered. In this study, thrombocytopenia was associated with higher total antivenom dose. Despite use of higher doses with lower pre-antivenom platelet counts, recurrent thrombocytopenia was common in follow-up.
Conclusion: In this NASBR RSE cohort, pre-antivenom thrombocytopenia was associated with higher total dose of antivenom.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

125. Wearable Biosensors to Evaluate Drug Craving During Recovery from Substance Use Disorder

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Background: Treatment for substance use disorder (SUD) suffers from high rates of relapse. The ability to identify moments of greatest risk and deliver targeted interventions in real time would provide a tremendous advantage over the current model of care. Wearable biosensors have the potential to fill this role.
Research Question: Can wearable biosensors detect changes in physiology related to drug craving during treatment for SUD?
Methods: This is an observational trial of individuals enrolled in an intensive outpatient treatment program for SUD. Participants wore a wrist-mounted biosensor on their non-dominant arm during all waking hours for a 4-day period. An event marker was used to denote any time they perceived drug craving or stress. Physiologic parameters measured continuously by the sensor included heart rate, skin conductance, skin temperature, and accelerometry in three axes (x, y and z axes). For analysis, raw biosensor data were evaluated 20 min before and 20 min after each marked event. A slide window technique was used to evaluate 5-min windows with a 4-min overlap. Within each window, mean variance was calculated and a Hilbert transformation was applied to extract relevant features (shape and scale parameters). Using a six-dimension hypothetical space with each of the sensor measures representing an axis, we defined a measure to characterize the pre- and post-event data and compared these using a Student's t test.
Results: Thirty participants were enrolled, and a total of 50 episodes of stress and 40 episodes of drug craving were analyzed. Craving episodes showed significantly different parameters than baseline on the y axis ($p =$

0.00), and significantly different parameters than stress on the x ($p = 0.009$) and y ($p = 0.00$) axes. Stress episodes were significantly different than drug craving episodes on the x ($p = 0.00$), y ($p = 0.003$), and z ($p = 0.03$) axes.
Discussion: By providing an objective measure of drug craving that can be ascertained in real time, wearable biosensors offer a unique opportunity for mobile interventions during substance abuse treatment.
Conclusion: Wearable biosensors can identify physiologic changes associated with drug craving in individuals during treatment for SUD.

126. Immuno-Toxicity of Cigarette Smoke on Immune Functions and DNA Damage in Alveolar Macrophages

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Background: Cigarette tobacco smoke is consisted from main-stream tobacco smoke (MTS) and secondhand tobacco smoke (STS). STS is released into the atmosphere, and may impact lung health in non-smoker. STS is inhaled into the lung by respiration and affect alveolar macrophage (AM). AM is playing an important role of immune system in the lung. However, the toxicity of STS on AM is not yet fully demonstrated compared with MTS.
Objective: In this study, we investigated the toxicity of STS on DNA damage and immune functions in AM.
Methods: Mice were exposed to STS of 20 cigarettes/day during 10 days by using STS exposure auto-machine. After STS exposure, AM were obtained by brochoalveolar lavage (BAL). AM was analyzed by SEM and TEM. TLRs and phagocytic activity, reactive oxygen species (ROS) generation of AM were determined by FACS. Expressions of cytokines mRNA of AM were measured by RT-PCR. DNA damage of AM was evaluated by comet assay.
Results: The number of AM was significantly ($p < 0.02$) increased in STS-exposed mice. The cell size and intra-cellar structure of AM were changed by STS. Phagocytic activity of AM was significantly ($p < 0.05$) inhibited by STS. Expressions of CD11b, TLR-2, TLR-4 and CD14 on AM were significantly ($p < 0.05$) inhibited by STS. ROS generations of AM were significantly ($p < 0.05$) increased by STS exposure. Expression of TNF-α mRNA in AM was significantly ($p < 0.02$) inhibited by STS. Tail moment and length of AM as indicator of DNA damage were significantly ($p < 0.05$) increased by STS.
Discussion: STS exposure caused the change of cell size and intracellular structure in AM. STS induced DNA damage in AM by ROS generation. The phagocytic activity, expressions of CD11b, TLR-2, TLR-4, CD14 and TNF-α mRNA in AM were decreased by STS. STS indicated toxicity for DNA of AM and inhibition of these immunological functions in AM was mediated by DNA damage.
Conclusion: These results suggest that inhibition of immune functions of AM by toxicity of STS may be associated with infection or development of pulmonary disease.

127. Effect of Plasmapheresis on Treating Disseminated Intravascular Coagulation (DIC) Caused by a *Hemiscorpius lepturus* (Gadim) Sting in Iran

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Background: The highest mortality from scorpion stings in Iran is due to the stings of a particular type of scorpion known as *Hemiscorpius lepturus* (Gadim in local language). The present study aimed at investigating the use of plasmapheresis to treat severe cases of *H. lepturus* stings.
Method: This pilot study was a randomized clinical trial conducted from June 2015 to June 2016 in Razi hospital of Ahvaz, Iran. Twenty-nine patients who had been stung and admitted to ICU because of disseminated intravascular coagulation (DIC) were randomly assigned into control (15 patients, supportive treatments) and plasmapheresis (14 patients, supportive treatments + plasmapheresis) groups, and the patient outcomes were compared between the two groups.
Findings: Eighteen patients were female (62%), and the mean of patient age was 24 ± 7. Most of the sting cases had occurred in the torso (15 patients, 52%). Only 10 patients (34%) arrived in the hospital within 12 h of being stung. There was no significant difference between the two groups in terms of the demographic and sting features. In the plasmapheresis group, hemoglobin level was significantly lower, while the PT and INR were measurably higher. In total, the plasmapheresis group experienced 29 sessions of treatment (an average of two sessions for each patient). Overall, 19 patients (66%) expired, whereas 10 patients (34%) experienced recovery with or without complications. The rate of recovery was significantly higher in the plasmapheresis group compared with controls, with eight patients (57%) in the plasmapheresis group surviving compared with two (14%) in the control group. The duration of hospitalization was higher in the plasmapheresis group. A comparison of the dead and recovered patients' features indicated that the dead patients arrived in the hospital significantly later than the recovered ones, and they also had lower platelet counts.
Conclusions: The findings of this study show that using plasmapheresis in treating DIC in patients stung by *H. lepturus* can prevent death and encourage recovery. However, prior to using plasmapheresis as a routine treatment for severe cases of people stung by this scorpion or other similar ones, further controlled studies with a larger sample size are needed.

128. Investigation of a Cell-Permeable Mitochondrial Prodrug on Mitochondrial Function in Human Blood Cells from Patients with CO Poisoning

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Background: Mitochondrial dysfunction has been implicated in carbon monoxide (CO) poisoning. Our own work has demonstrated decreased Complex IV (CIV) respiration in patients with CO poisoning. Treatment of CO poisoning is limited to hyperbaric (HBO) therapy. We evaluated a new pharmacological strategy using a succinate prodrug (NV118) in peripheral blood mononuclear cells (PBMCs) obtained from subjects with CO poisoning (CO group) and healthy controls (Control group).
Methods: This is an ongoing prospective observational study in a single site academic emergency department. PBMCs from subjects in the CO and Control group were analyzed with high-resolution respirometry (OROBOROS) to obtain the following parameters of respiration: Routine (resting state), LEAK (proton leak), ETS (maximal respiration) and residual oxygen consumption. In addition to obtaining baseline respiration, NV118 (100 uM) was injected and the same parameters of respiration were obtained for comparison.
Results: We enrolled 16 patients (6 in the CO group and 10 in the Control group for comparison) for detailed measurement of mitochondrial respiration. The mean COHb level was (36.3 ± 7). 83% ($n = 5$) of CO exposures were related to heat generators and one was related to car exhaust. Patient demographics and clinical characteristics of the CO group include: 50% ($n = 3$) were men; mean age of the CO group was 45.7 ± 23.5 years; 75% ($n = 3$) presented with syncope and 25% ($n = 1$) presented with altered mental status; 83% ($n = 5$) of patients underwent HBO and 25% ($n = 1$) of patients received normobaric oxygen. All six patients survived to hospital discharge. PMBCs obtained from subjects in the CO group had overall significantly lower respiration compared to the Control group ($P < 0.0001$). There was a significant increase in respiration with NV118, specifically with an increase in ETS and CIV-linked respiration ($P < 0.0001$).

Discussion: PBMCs from the CO and Control group differed in both routine and ETS respiration. PBMCs from both groups demonstrated increased CII-linked activity, ETS and CIV respiration with NV118.
Conclusion: Our results suggest that the NV118 increases CII respiration to improve CIV respiration with CO poisoning. Mitochondrial-directed therapy offers a potential future strategy in managing CO poisoning.

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Day 3: Posters, 129–174

129. Pegloticase-Induced Methemoglobinemia and Hemolytic Anemia

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Background: Pegloticase is a pegylated uric acid-specific enzyme, approved for the treatment of refractory, chronic gout in adults in 2010 by the US Food and Drug Administration. It catalyzes the conversion of urate to allantoin that is then renally excreted. This conversion induces oxidative stress producing large amounts of hydrogen peroxide, and is contraindicated for use in patients with known glucose-6-phosohate dehydrogenase (G6PD) deficiency. It has a long elimination half-life that ranges from 170 to 1049 h.
Methods: Single-patient chart review.
Case: A 59-year-old Hispanic man with refractory gout presented to the emergency department (ED) with shortness of breath. He had been treated with IV pegloticase earlier that day. Initial labs were significant for a leukocytosis of 23,000/μL, hemoglobin 9.5 g/dL, and an elevated total bilirubin of 5.2 mg/dL concerning for active hemolysis. Outside testing for G6PD deficiency was erroneously reported as negative prior to treatment. His methemoglobinemia level peaked at 13.2%, and he developed increasing dyspnea and hypoxia requiring supplemental oxygen. He was transfused 6 units of packed red blood cells for ongoing hemolysis (hemoglobin nadir of 6.7 g/dL). Given his history of underlying G6PD deficiency, methylene blue was not recommended, and he was administered ascorbic acid 500 mg daily. The patient was discharged home on hospital day 4 with stable hemoglobin of 7.0–7.5 g/dL, methemoglobin level of 0.8%, total bilirubin 1.5 mg/dL, and BUN 15 mg/dL. A repeat G6PD level, performed the day after admission, was abnormal at 5.2 (reference = 9.9–16.6).
Discussion: This case presents an interesting dilemma in the treatment of medication-induced methemoglobinemia and hemolytic anemia in a G6PD-deficient individual. We considered the use of ascorbic acid, hyperbaric oxygen therapy, exchange transfusion and methylene blue. Ultimately methylene blue was withheld, but research has shown that the degree of hemolysis depends on the G6PD deficiency genotype variant, suggesting that a careful trial of methylene blue for treatment of symptomatic methemoglobinemia may be reasonable.
Conclusion: We describe a case of severe hemolysis and methemoglobinemia in a G6PD-deficient patient treated with pegloticase.

130. A Fatal Exposure to Hydrogen Sulfide

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Background: Hydrogen Sulfide (H_2S) is considered a "knock down" agent. Inhalation of H2S causes cellular asphyxia, collapse, and cardiac arrest. We report a case of a 56-year-old male who suffered a fatal exposure to hydrogen sulfide gas while cleaning the interior of a hazardous waste disposal truck.
Methods: Single-patient chart review.
Case: A 56–year-old male was cleaning the interior of a tanker truck at a hazardous waste disposal site. He removed his personal protective equipment to better visualize the interior of the tank. He then stood up and collapsed. He fell from the top of the truck, landing on his head. Coworkers found him in cardiac arrest and performed CPR. EMS arrived and transported the patient to a local ED. On arrival to the ED, ACLS protocol was initiated. His evaluation was complicated by a lack of information regarding hazardous materials present at his work site, and the presence of white powder covering his body. Because of a concern for cyanide exposure, the patient was given hydroxocobalamin with rapid return of circulation. Following resuscitation, diagnostic testing showed severe metabolic and respiratory acidosis. Radiographic studies showed multiple traumatic injuries including subarachnoid hemorrhage and cerebral edema. Testing at the exposure site by HAZMAT confirmed the presence of hydrogen sulfide gas. The white powder was identified as calcium carbonate. In the ICU, his acid-base status improved; however, his cardiovascular status deteriorated. Based on his poor neurologic prognosis, further resuscitative measures were not attempted. He died on hospital day two.
Discussion: Clinicians should maintain awareness of hydrogen sulfide as a "knock down" gas and potential cause of sudden cardiac arrest. Inhalation of large quantities can be fatal and lead to cellular asphyxia and cardiopulmonary arrest. In this case, there was rapid return of circulation following administration of hydroxocobalamin, which is consistent with prior animal studies and case reports suggesting efficacy.
Conclusion: Those working near sources of hydrogen sulfide should wear personal protective equipment. Assessment of potentially hazardous exposures and appropriate decontamination procedures can assist in the rapid treatment of life-threatening exposures. Hydroxocobalamin should be considered for severe toxicity secondary to hydrogen sulfide exposure.

131. Mass Hydrogen Sulfide Poisoning at a Coal-Fired Power Plant

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Background: Hydrogen sulfide (H_2S) is a potentially deadly gas that causes cellular anoxia due to inhibition of complex IV of the electron transport chain. Occupational poisoning with H_2S has been reported in the setting of sewage systems, oil and gas production, animal containment, and other industrial processes. However, H_2S toxicity has not been described at coal-fired power plants.
Hypothesis: Coal-fired power plants are a potential source of mass H_2S poisoning.
Methods: This is a retrospective review. Data were abstracted from Poison Center records and medical records.
Results: Six workers at a coal-fired power plant were exposed to gas while performing maintenance in a confined underground pit. All six workers experienced sudden syncope, and two died at the scene. The remaining four individuals were extricated and transferred to nearby hospitals. Two individuals had mild respiratory and mucous membrane irritation, with one requiring thoracostomy for a pneumothorax obtained after falling from the syncopal event. The other two individuals experienced respiratory depression and obtundation and were intubated on scene. The first individual was extubated the following morning and rapidly transitioned to room air with no further cardiopulmonary symptoms; he also had marked bilateral chemosis, but experienced no pain or

visual symptoms. The second intubated individual developed Acute Respiratory Distress Syndrome and required initiation of Extracorporeal Membrane Oxygenation (ECMO) for persistent hypoxia. After 2 days, the patient was taken off pressors, and was decannulated and weaned from the ventilator after 4 days. This individual displayed mild cognitive symptoms following extubation including short-term memory deficits. None of the surviving patients required administration of sodium nitrite. H_2S exposure was confirmed by the owner of the power plant.
Discussion: Coal-fired power plants have been identified as large emitters of H_2S, and the recent exposure of six individuals is consistent with acute H_2S toxicity. We report the first known incident of mass H_2S poisoning from occupational exposure at a coal-fired power plant. Morbidity ranged from mild respiratory effects to death within minutes.
Conclusion: Coal-fired power plants are a confirmed source of mass H_2S poisoning; respiratory failure secondary to pulmonary edema from H_2S poisoning may be treated with ECMO.

132. Death Following Lidocaine Inhalation for Treatment of Gastroesophageal Reflux Disease

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Background: Lidocaine is a Vaughan Williams Class IB antiarrhythmic agent and local anesthetic. Systemic toxicity manifests as an extension of lidocaine's mechanism of action, which includes sodium channel blockade. We present a case of fatal lidocaine toxicity following inhalation of lidocaine powder imported from China for treatment of GERD.
Hypothesis: Inhalation of lidocaine powder can lead to severe systemic toxicity and death.
Methods: Single-patient chart review.
Case: A 33-year-old male presented to the emergency department in cardiac arrest following inhalation of lidocaine powder he had imported from China for treatment of gastroesophageal reflux disease. Initial cardiopulmonary resuscitation was successful, and the patient was intubated and placed on norepinephrine and dopamine infusions for hypotension (66/34 mmHg). The patient's initial electrocardiogram showed a QRS interval of 154 ms and a QTc of 515 ms with a terminal R wave in the aVR lead. The patient received sodium bicarbonate for QRS prolongation and intravenous fat emulsion as recommended by the toxicology service. The patient's blood pressure stabilized to 104/52 mmHg and QRS narrowed to 120 ms following administration of these therapies; however, he remained unresponsive to physical exam with fixed and dilated pupils. Computed tomography of the head showed anoxic brain injury with swelling and possible herniation. The patient was declared brain dead and care was withdrawn on hospital day two. The product the patient was using was sent for gas chromatography/mass spectroscopy and confirmed positive for lidocaine. Serum lidocaine level was obtained and found to be > 12 mcg (reference therapeutic range of 2–5 mcg/mL).
Discussion: Lidocaine cardiotoxicity is well-documented in the literature, and death has been reported following insufflation of cocaine adulterated with lidocaine. To our knowledge, this is the first report of a fatality due to intentional inhalation of lidocaine powder to treat symptoms of GERD. It also highlights how easily dangerous and unregulated substances can be obtained by well-meaning individuals from the Internet.
Conclusion: Lidocaine powder inhalation can be fatal secondary to complications of severe cardiovascular toxicity. It is easily obtained over the Internet.

133. A Review of Cyanide Poisoning Deaths in the Fatality Reviews of the NPDS Annual Report 2006–2015.

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Background: Cyanide is a potent cellular inhibitor, rapidly causing altered mentation, collapse, and death following exposure. Although multiple antidotes exist, prompt recognition of cyanide toxicity with antidotal therapy is paramount to survival.
Research Question: Are there common themes in characteristics or clinical findings of fatal cyanide poisonings that could assist in recognition and provide opportunities for early antidote administration?
Methods: The NPDS Fatality Review from 2006 to 2015 was systematically searched using the keyword "cyanide." Fatalities where cyanide was attributed as "undoubtedly" the cause of death were abstracted using predefined variables on a standardized tool. Relationships between pH, lactate, and cyanide concentration were assessed via linear regression.
Results: Seventeen cases of cyanide fatalities were identified and eight (47%) used in the final analysis. The ages ranged from 19 to 85 years; 12 were male (70%). Thirteen cases were suicides (76%), 3 unintentional (18%) and one homicide. 10 (59%) were oral ingestions. 9 (53%) involved out of hospital arrests. All had elevated lactates, ranging from 12 to 25 mmol/L. Cyanide antidotes were used in 10 patients (58%): 5 received the kit and 5 received hydroxocobalamin. Serum cyanide concentrations ranged from 2.8 to 290 mg/L. No linear correlation existed between pH and lactate or cyanide and lactate ($r = -0.25$, $p = 0.55$ and $r = 0.8$, $p = 0.48$ respectively). There was a trend towards a significant inverse correlation between pH and cyanide concentrations ($r = -0.7$, $p = 0.056$).
Discussion: In this series of 17 cyanide-related fatalities, a lactate level > 10 mmol/L was uniformly present although did not correlate with either pH or cyanide concentration. These findings may be confounded by ascertainment bias, and patients with less overt cyanide poisoning may have been excluded from the NPDS. Most cases were suicides; however, the cyanide source was not always mentioned. More thorough data would help clarify the role of rapid, easily obtainable surrogate markers in the early diagnosis of cyanide poisoning, and could aid future regulatory and harm reduction efforts to reduce the availability of this deadly toxin.
Conclusion: Cyanide rapidly causes cardiac arrest heralded by profoundly elevated lactate concentration. This pattern should promote prompt consideration of antidotal therapy.

134. Antique Weed Killer: More Than Just a Collectible

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Background: Acute exposure to arsenical herbicides is an uncommon cause of morbidity and mortality in the USA, particularly after most were removed from the market in 2009.
Methods: Single-patient chart review.
Case: A 36-year-old male ingested the contents of an unlabeled brown bottle of "antique weed killer" in a suicide attempt. He rapidly developed emesis and diarrhea. He presented lethargic, hypoglycemic, hypothermic, hypotensive, and tachypneic. An EKG demonstrated sinus tachycardia with QRS and QTc prolongation to 109 and 485 ms, respectively, as well as diffuse ST depressions. His laboratory studies were notable for hypokalemia, lactic acidosis, and renal insufficiency. Supportive care was initiated, including endotracheal intubation, intravenous fluids,

vasopressors, sodium bicarbonate, and electrolyte repletion. Nonetheless, he continued to deteriorate and his cardiac rhythm degenerated to ventricular fibrillation. He died approximately 4 h post ingestion.
We recovered a broken brown bottle, the remnants of which were coated with a chalky gray residue. This was reconstituted in distilled water and evaluated using inductively coupled plasma-mass spectrometry. The reconstituted residue contained 6755 ppm arsenic, and no appreciable quantity of chlorinated herbicides. Blood and urine were not available for further testing and autopsy was not performed.
Discussion: Arsenical pesticides and herbicides can still be found in garages and farms throughout the USA, and are still used in select settings. Arsenic inhibits several key metabolic enzymes including pyruvate dehydrogenase, decreasing production of acetyl-CoA and directly impairing mitochondrial respiration. Patients with large, acute exposures develop abdominal pain, vomiting, and voluminous "bloody rice water" diarrhea within minutes to hours. Patients' breath and secretions may smell of garlic. EKG changes including QRS and QTc prolongation as well as ST depression can occur. Death occurs from volume loss, electrolyte depletion, and subsequent circulatory collapse. Treatment is mainly supportive. Aggressive gastrointestinal decontamination may be helpful. Successful chelation with BAL, DMPS, and DMSA has been reported.
Conclusion: Clinicians should be aware of the signs and symptoms of acute arsenic poisoning, and maintain a high index of suspicion especially after exposure to pesticides and herbicides.

135. Severe Leukoencephalopathy from Chronic Mothball Abuse

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Background: *Para*-dichlorobenzene (PDCB) is a chlorinated aromatic hydrocarbon and active ingredient in many types of mothballs and certain deodorizers. Routine use of PDCB-containing household products poses little risk of significant toxicity, whereas occupational exposure can cause skin and eye irritation. A limited number of cases of PDCB toxicity exist in the literature, almost exclusively from mothball inhalation or ingestion. We describe a case of chronic PDCB exposure from mothball pica resulting in severe toxic encephalopathy.
Methods: Single-patient chart review.
Case Report: A healthy 56-year-old woman presented to the emergency department with progressively declining mental status. Over 4 weeks, the patient became increasingly somnolent and less interactive with anorexia and weight loss. She developed urinary incontinence and inability to ambulate or speak. Further history revealed the patient was compulsively chewing and eating mothballs for at least 6 months prior to presentation. On initial evaluation, the patient was nonverbal and minimally responsive. Vitals were notable for sinus tachycardia (HR 128). Laboratory workup, urine toxicology screen and non-contrast head computed tomography were all unremarkable. Brain MRI revealed extensive white matter abnormalities consistent with a toxic leukoencephalopathy. Subsequently, an elevated serum *para*-dichlorobenzene of 8.7 μg/dl (normal < 0.02 μg/dl) was found. Based on these findings, the patient's symptoms were attributed to PDCB-induced leukoencephalopathy secondary to mothball pica. The patient's neurologic status did not change significantly during her 2-week hospital stay. Eventually, a feeding tube was placed and she was discharged home under the care of her family.
Discussion: PDCB-induced neurotoxicity, although rare, may result in leukoencephalopathy. Clinical findings are heterogeneous, making the diagnosis challenging. Unfortunately, treatment is limited to removal from exposure to the toxin and supportive care. In our patient, clinical manifestations occurred over months of mothball ingestion. Prior cases, however, demonstrate variable time course of symptom onset and may be related to other factors such as mode, duration, and amount ingested as well as comorbidities. While previous cases have noted complete neurologic recovery after stopping exposure, others have documented permanent neurological sequelae.
Conclusion: Early identification of PDCB-neurotoxicity requires a thorough exposure history and should be suspected in patients presenting with heterogeneous neurologic complaints and a history of pica.

136. Correlation of Clinical Score and Serum Acetylcholinesterase Level as a Predictor of Outcome Among Patients with Acute Organophosphate Poisoning Admitted in Emergency Ward of Tertiary Hospital in Eastern Nepal

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Background: Organophosphorus (OP) insecticide self-poisoning is a major clinical and public health problem across much of rural Asia with hundreds of thousands of deaths each year. Owing to the limited availability of facilities and resources, all OP poisoning patients are not managed in intensive care units. Monitoring a patient's acetylcholinesterase status after organophosphate poisoning enables the verification of substantial exposure to anticholinesterase agents. POP (Peradeniya Organophosphorus Poisoning) scoring done in OP poison before atropinization showed that higher POP score has poor outcome in terms of survival and duration of hospital stay.
Methods: One hundred patients fulfilling the inclusion criteria were included, and patients were categorized according to POP scale. At the same time informed consent was taken from the patient or their attendants for withdrawal of blood. The outcome of the study was measured as number of death, transferred in ICU ward, inpatient medical wards and duration of stay in hospital.
Results: The correlation between severity of poisoning as assessed by POP scale and serum acetylcholinesterase was significant ($P = 0.01$). Spearman's Rho Coefficient showed 0.471 is a better negative correlation between POP score and serum acetylcholinesterase level. Serum acetylcholinesterase level also correlated better with POP score for the need of atropine vs. PAM (coefficient = 0.449 vs. 0.427; $P = 0.01$) and (coefficient = 0.589 vs. 0.33; $P = 0.01$). Serum acetylcholinesterase correlated well with the length of hospital stay (coefficient = 0.374; $P = 0.01$) as compared to POP score (coefficient = 0.244; $P = 0.05$). Similarly, POP score correlated well with Serum Gamma GT (coefficient = 0.320; P = 0.01). Kruskal-Wallis Test when applied also correlated well with POP score ($P = 0.004$), serum acetylcholinesterase level ($P = 0.021$) and duration of hospital stay ($P = 0.010$).
Conclusion: Peradeniya Organophosphorus Poisoning scale correlated well with serum acetylcholinesterase level and outcome among patients with acute organophosphate poisoning.

137. Analysis of Beta Blocker and Calcium Channel Blocker Overdoses Treated with High-Dose Insulin Euglycaemic Therapy and/or Catecholamine Infusion

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Background: Along with catecholamine infusions, high-dose insulin euglycaemic therapy (HIET) is often used to treat beta blocker (BB) and calcium channel blocker (CCB) poisoning.
Objective: Review clinical features and treatment of BB and CCB poisoning in patients presenting to our toxicology service.
Method: Retrospective, descriptive series of BB or CCB toxicity. Variables recorded include demographics, cardiovascular (CVS) drugs ingested, defined-daily-doses (DDD), vital signs, IV fluid, inotrope, and vasoactive agent doses.

Results: Twenty-seven patients; 14 received HIET (BB in 70%, non-dihydropyridine-CCB 30%, deliberate-self-poisoning [DSP] 71%), 13 were treated with only catecholamines (BB 70%, non-dihydropyridine-CCB 30%, DSP 54%). The most frequently ingested BBs were metoprolol and atenolol. Multiple CVS drugs were ingested in 78% of cases. These included amlodipine, other vasodilators, and diuretics. There was no difference in mean age (HIET 61 years vs catecholamines 70 years). Patients receiving HIET were more commonly male (57 vs 15%, $p = 0.04$, OR 7.3, 95% CI 1.1–46) and ingested more than two defined-daily-doses of BB and/or non-dihydropyridine-CCB (71 vs 23%, $p = 0.02$, OR 8.3, 95% CI 1.4–47). Pre-treatment mean-SBP (HIET 78 mmHg vs catecholamines 76 mmHg) and median pulse (HIET 45 bpm vs catecholamines 55 bpm) were similar. The HIET group was more likely to receive multiple vasoactive therapies (100 vs 38%, $p = 0.0006$, OR 45, 95% CI 2.2–915) and catecholamines were commonly started before HIET. Mean time to initiation of HIET was 3.3 h; however, blood pressure improvement was often seen before this. Mean HIET infusion duration was 19.3 h. HIET patients had larger IV fluid volumes administered in the first 24 h (HIET mean 5.0 L vs catecholamines 3.1 L, $p = 0.01$). Mean time to stopping all IV-therapies was HIET 21 h vs catecholamines 17 h. Echocardiographic assessment occurred infrequently and mostly after catecholamines had been started.
Conclusion: CVS toxicity in this cohort was commonly the result of a mix of negative chronotropic/inotropic and vasodilator agents. Patients receiving HIET were more likely to ingest larger doses of BBs and non-dihydropyridine CCBs and be treated with multiple inotropes, suggesting they may have been more unwell. However, in this heterogeneous cohort, it is unclear whether the addition of HIET to catecholamines in those with mixed CVS drug overdose had benefits over catecholamines alone.

138. A Contemporary Look at the Use of Multiple-Use Activated Charcoal in Poisoned Patients

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Background: Multiple-dose activated charcoal (MDAC) has been noted to enhance the elimination of drugs in animal and volunteer studies. Expert guidelines suggest considering MDAC in specific drugs including carbamazepine, dapsone, phenobarbital, quinine, or theophylline. Significant adverse effects such as nausea, vomiting, aspiration, ileus, and gastrointestinal obstruction have been reported.
Objective: The aim of this study was to examine the circumstances in which MDAC is currently being utilized on cases reported to a poison center and any reported complications.
Methods: This was a retrospective review of human exposure cases where MDAC was coded in a statewide poison system's database from January 2007 to December 2016 system. Patients were included if they were noted to receive two or more charcoal doses. Information extracted included patient demographics, substance ingested, reason for use, and any related adverse events.
Results: A total of 864 calls were reviewed; 443 cases were excluded for incorrect coding of MDAC, duplicate cases, or cases in which the total number of doses could not be determined. MDAC was recommended most often for ingestions involving salicylates, carbamazepine, valproic acid, quetiapine, and bupropion. The two common reasons for MDAC use were possible disruption of drug enterohepatic circulation and suspected bezoar formation. Two hundred seventy-eight patients received two doses of activated charcoal, and 143 received > 2 charcoal doses. The rate of aspiration was 0.4 and 0.7% in those who received two doses and those who received > 2, respectively. There were no cases of obstruction, but three patients with > 2 doses were noted to have an ileus, resulting in a rate of 2.1%. Nausea or vomiting was noted in 32 (11.5%) patients who received two doses compared to 15 (10.5%) that received > 2 doses. Those that developed adverse effects were not associated with worse outcomes.
Conclusion: MDAC is being utilized in more circumstances than suggested in published guidelines. There was a higher rate of complication with regard to aspiration and ileus in those that received more than two charcoal doses. Complications associated with MDAC can occur and this may be a dose-related response.

139. Hooked Up for Life! ECLS in a Patient with Severe Aluminum Phosphide Toxicity

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Background: Aluminum phosphide (AlP) is a highly toxic fumigant that is restricted in the USA. When exposed to humidity or water, AlP generates phosphine gas, a mitochondrial toxin that can produce cardiovascular collapse, respiratory failure, metabolic acidosis, and death.
Hypothesis: The use of extracorporeal life support (ECLS) in patients with severe AlP toxicity increases chances of survival.
Methods: Single-patient chart review.
Case: A 3-year-old girl with no significant past medical history presented to the emergency department with 10 h of cough and vomiting. Symptoms started after her father placed AlP pellets throughout the house for rodent control. Of note, her 47-year-old mother, 16-year-old brother, and 21-year-old sister all presented at the same time with minor gastrointestinal and upper respiratory symptoms that resolved quickly. The patient's vital signs were BP 60/40 mmHg, HR 150 beats/min, RR 25 breaths/min, T 99.5 °F, O_2 Sat 100%. She was noted to be somnolent and had dry mucous membranes with delayed capillary refill. Venous blood gas showed pH 7.32; PCO_2 28 mmHg, calculated HCO_3 14 mEq/L, and a lactate 4.2 mmol/L. Anion gap was 29 mmol/L. ECG showed diffuse ST segment depressions. She remained hypotensive despite intravenous fluids and was started on IV dopamine. She was transferred to an ECLS center 2 h after presentation. Shortly after transfer, the patient had a ventricular tachycardia arrest and was connected to veno-arterial ECLS after 90 min of resuscitation. She was started on IV *N*-acetylcysteine and oral vitamin E as well as intravenous L-carnitine. Her hospital course was complicated by ventricular dysrhythmias, seizures and bacteremia, hepatic injury, pulmonary edema and acute kidney failure requiring dialysis. Cardiac function slowly improved, and the patient was weaned off ECLS on day 15 of admission with an intact mental status and no reported neurologic sequelae.
Discussion: Phosphine poisoning is challenging for the provider since it is often lethal, has no specific antidotes and rarely occurs in the USA.
Conclusion: Early transfer to an ECLS-capable center and aggressive treatment in aluminum phosphide toxicity may be associated with better outcomes.

140. The Use of Veno-Venous ECMO for Severe Acute Respiratory Distress Syndrome Due to Toxic Inhalation

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Background: One of the most intensive practices of supportive care is extracorporeal membrane oxygenation (ECMO). While veno-arterial ECMO is most well-described in the toxicologic literature for treatment

of cardiogenic shock due to acute overdose, veno-venous (VV) ECMO is an important modality to consider in the treatment of acute respiratory distress syndrome due to toxic inhalation.
Methods: Single-patient chart review.
Case: A 71-year-old male with a history of hypertension, hyperlipidemia, and diabetes presented to the ED complaining of cough, chest burning, and dizziness, beginning 5 h prior to arrival. The patient denied any prior respiratory comorbidities. He admitted to using sulfuric acid and nitric acid to clean silver without personal protective equipment. Initial vital signs were notable for a RR 22 and SpO_2 84%. He did not have respiratory distress, but had diffuse crackles on exam. Chest x-ray showed diffuse interstitial opacities. The patient was placed on BIPAP and transferred to the ICU. He rapidly developed severe hypoxia with Sp O_2 of 80% on BIPAP and was intubated. In the ICU, the patient had a FiO_2 1.0 with a PaO_2 55–60. Pulmonology was consulted and recommended VV-ECMO for severe ARDS secondary to inhalation injuries. Hospital course was complicated by bacterial pneumonia that was managed with intravenous antibiotics. The patient received VV-ECMO for 10 days. On day 15, he underwent a tracheostomy and, at the time of discharge, the patient was being managed with pressure support ventilation at night and tracheostomy collar during the day. On hospital day 26, he was discharged to inpatient rehabilitation.
Discussion: Symptoms of sulfuric acid and nitric acid inhalation exposure include upper respiratory irritation, dyspnea and pulmonary edema. Death may occur from hemodynamic instability and acute lung injury. Management is dependent on severity but consists of chest x-ray, oxygen supplementation, bronchodilators, early intubation and bronchoscopy. VV-ECMO may be indicated in patients with severe ARDS and criteria are determined by FiO_2/PaO_2.
Conclusion: VV-ECMO is an important modality to consider in the management of patients with severe ARDS due to toxic inhalation and may contribute to decreased mortality in these severely ill patients.

141. Sodium Bicarbonate Therapy: Treatment Recommendations and Clinical Outcomes as Reported Through the ToxIC Registry

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Background: Sodium bicarbonate is an antidote for sodium channel blockade in poisoned patients with QRS widening on electrocardiogram. Significant practice variation exists regarding specific regimens. Characterizing current use of this antidote is important given the national shortage.
Hypothesis: We aimed to evaluate criteria for initiation and discontinuation, as well as dosing regimens, and complications among sodium channel blocker-poisoned patients treated with sodium bicarbonate.
Methods: Using the ToxIC Registry, a prospective observational case series of sodium bicarbonate use was performed using a 21-question data collection tool. Completed cases were collected from April 2015 through March 2017 encompassing 12 sites.
Results: Out of 28 patients, 16 were male and 12 were female; mean age was 32 years. Primary agents listed were amitriptyline, nortriptyline, carbamazepine, bupropion, duloxetine, chlorpheniramine, doxepin, diphenhydramine, flecainide, diethylene glycol, tramadol, rodenticide, cocaine, and an unknown agent. Medical Toxicology services recommended initiating sodium bicarbonate therapy for a QRS duration greater than 100–120 ms. 60.7% (17) received sodium bicarbonate boluses and infusions, 32.1% (9) received boluses only, and 7.1% (2) received infusion only. All services used 150 mEq/L as the concentration of sodium bicarbonate infusion. Duration of infusion ranged from 3 to 95 h. Mean improvement after sodium bicarbonate therapy was 26.4 ms ± 22.7 ms (95% CI − 34.8 to − 18.0). Four patients had ventricular tachycardia and other therapies given included lipid emulsion, hypertonic saline, amiodarone, and cardioversion. One patient was defibrillated prior to the administration of sodium bicarbonate. Six cases had rewidening of the QRS after the cessation of sodium bicarbonate (range 106–174 ms occurring at 0.5 to 24 h after stopping therapy). Sodium bicarbonate was re-initiated in two cases. Complications occurred in four cases and included hypokalemia, hypernatremia, significant alkalemia, hypocalcemia, and QTc prolongation.
Discussion: In this case series, sodium bicarbonate was used for multiple agents with an average reduction in QRS of 26.4 ms. Other therapies were minimally used.
Conclusions: Sodium bicarbonate resulted in a clinically significant reduction in QRS widening in patients with sodium channel blockade; further study is warranted to determine which xenobiotics are most responsive to therapy along with appropriate dosing and duration.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

142. Massive Diphenhydramine Overdose Successfully Treated with Extracorporeal Membrane Oxygenation

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Background: Extracorporeal membrane oxygenation (ECMO) is a rescue therapy for patients with acute respiratory distress syndrome (ARDS) and refractory cardiogenic shock. Patients with diphenhydramine overdose can develop severe cardiotoxicity, including wide-complex tachycardia leading to cardiac arrest. There are no reported cases of confirmed diphenhydramine poisoning successfully treated with ECMO.
Hypothesis: ECMO is effective in severe diphenhydramine poisoning with ARDS and refractory cardiogenic shock.
Methods: Single-patient chart review.
Case: An 18-year-old female with a history of depression was brought to the emergency department (ED) after being found unresponsive in her car with an empty package of diphenhydramine and empty bottle of ibuprofen. Initial emergency medical services (EMS) vital signs were BP 60 mmHg/palp, HR 114 bpm, and RR 12 bpm. Bag-valve mask ventilation was initiated en route to the hospital. In the ED, the patient was unresponsive and then began actively seizing. Cardiac monitoring revealed a wide-complex tachycardia, and then the patient went into a pulseless electrical activity (PEA) cardiac arrest. Return of spontaneous circulation occurred after 6 min of CPR, during which she was intubated and received intravenous sodium bicarbonate, epinephrine, dextrose, calcium, and normal saline. Despite vasopressors and maximum ventilator support, the patient developed ARDS and refractory cardiogenic shock. She was placed on veno-arterial (VA) ECMO. The patient received VA ECMO for 3 days, then veno-venous (VV) ECMO for 11 days, and mechanical ventilation for a total of 21 days. Her course was complicated by rhabdomyolysis, acute kidney injury requiring dialysis, acute liver failure, and compartment syndrome of her left lower extremity necessitating fasciotomy. She was discharged to inpatient rehabilitation neurologically intact 30 days after presentation. A serum diphenhydramine concentration obtained in the ED on arrival was 6000 ng/mL (50–100 ng/mL). Acetaminophen, salicylate, and urine toxicology testing were all negative.

Discussion: We believe this is the first case of confirmed diphenhydramine poisoning successfully treated with ECMO. This case report supports the use of ECMO in poisonings with cardiovascular collapse secondary to a cardiac toxin.
Conclusion: ECMO can be used as a life-saving treatment modality in severe diphenhydramine overdose refractory to conventional therapy.

143. The Use of Physostigmine Infusion for the Treatment of Anticholinergic Delirium

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Background: Physostigmine is an established antidote for anticholinergic delirium. However, its duration of action is shorter than most anticholinergic medications, so multiple doses may be necessary for symptom control. Literature describing use of continuous physostigmine infusion when frequent bolus dosing is required is limited to one adult and two pediatric case reports. These reports document use of 2–3 mg/h, but evidence supporting this dosing exists only in these cases.
Hypothesis: A physostigmine infusion (0.02 mg/mL in D5W) given at 1 mg/h can be safely used to treat anticholinergic delirium and reduce benzodiazepine requirements.
Methods: Single-patient chart review.
Case: A 37-year-old male with bipolar disorder, schizoaffective disorder, and alcohol abuse presented to a psychiatric facility with 1 week of worsening delirium. He was evaluated, given 5 mg haloperidol and 50 mg diphenhydramine intramuscularly, and transferred for further evaluation when he did not improve. On arrival, he was tachycardic with dilated pupils, dry mucous membranes, skin flushing, and agitation consistent with an anticholinergic toxidrome. He failed to respond to 5 mg lorazepam IV but had clinical improvement following 1 mg IV physostigmine. Repeat dosing 15 min later resulted in symptom resolution. Over the next 24 h, he developed worsening delirium, agitation, tachycardia, hypertension, and a temperature of 103.1 °F. Given the concern for alcohol withdrawal, 20 mg IV diazepam was given without response. After 1 mg physostigmine IV, he was alert, reported missing his recent paliperidone injection, running out of lithium and buspirone, and ingesting excessive benztropine to compensate for his missed medications. An hour later, his agitation recurred without response to diazepam. A bolus of 0.5 mg physostigmine IV was given with resolution of agitation and an infusion at 1 mg/h initiated. The physostigmine infusion was continued for 7 h without cholinergic symptoms, recurrence of agitation, or further benzodiazepine use.
Discussion: Similar to previous case reports, the physostigmine infusion in our patient allowed for sustained clinical improvement without complications and reduced his benzodiazepine requirements.
Conclusion: Our case demonstrates successful use of a 1 mg/h physostigmine infusion; adding to limited existing evidence supporting safety and efficacy of continuous physostigmine infusions.

144. Weight-Based Dosing for Intravenous Glucagon Bolus Is Associated with Chronotropic Response in Beta-Blocker Toxicity

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Background: Glucagon has been recognized as first-line antidotal therapy for beta-blocker overdose. The evidence for this indication is limited to human case reports and animal trials.
Research Question: What patient characteristics are associated with a chronotropic response to glucagon?
Methods: A retrospective cohort study was conducted in adult patients with high clinical suspicion of beta-blocker toxicity who received high-dose IV glucagon bolus at an academic medical center from December 2011 to December 2016. Subjects were dichotomized as good responders (10-min HR change greater than or equal to 10 bpm) and poor responders (10-min HR change less than 10 bpm). The primary outcome was a comparative analysis of patient characteristics between both groups. Secondary outcomes include change in 10-min heart rate (HR) and mean arterial pressure (MAP) and percentage of subjects requiring adjuvant treatments.
Results: Thirty-nine patients were included (good responders, $n = 22$; poor responders, $n = 17$). Thirty-five (90%) patients received glucagon 5 mg and four (10%) patients received glucagon 10 mg. Good responders had a lower actual body weight compared to poor responders (77.8 versus 87.3 kg; $p = 0.044$, t test). Weight-based glucagon dosing was significantly higher for the good responders (63.9 versus 56.4 mcg/kg; $p = 0.036$, t test). In the overall population, the median heart rate increased 12 bpm (IQR 5–18 bpm) and MAP increased 11 mmHg (IQR 2.3–18.5 mmHg) 10 min post-glucagon bolus.
Discussion: Glucagon showed favorable hemodynamic effects in the majority of the patients, and we found an association with a higher weight-based glucagon dose and a positive chronotropic response. Fixed adult doses may not be sufficient in producing an adequate response, especially in overweight patients.
Conclusion: To optimize the chronotropic effect of glucagon therapy in beta-blocker toxicity, weight-based dosing, especially in overweight patients, should be targeted.

145. Recommendations for Gastrointestinal Decontamination in Medication Package Inserts

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Background: Position statements from the American Academy of Clinical Toxicology (AACT) indicate that gastrointestinal (GI) decontamination should not be administered routinely to poisoned patients. However, FDA-approved package inserts often make recommendations regarding the use of GI decontamination in medication overdose.
Research question: The goal of this study is to assess the frequency and nature of recommendations for GI decontamination in the package inserts for medications commonly involved in overdose.
Methods: A list of medications frequently involved in overdose was generated by searching the 2015 annual report of the American Association of Poison Control Centers' National Poison Data System (2015 NPDS). Included were the top ten medications reported to poison control centers, and the top ten medications involved in fatalities. The "Overdosage" section of each package insert was analyzed for recommendations regarding GI decontamination, including decontamination modality and strength of recommendation.
Results: A list of 17 unique medications was identified, including over-the-counter analgesics, prescription opioid products, cardiac medications, and antidepressants. Of 15 package inserts available for review, eight (53%) contained recommendations regarding GI decontamination. Of these, recommendations included the use of activated charcoal (AC) in seven (87.5%) medications, AC alone in two (25%), gastric lavage in four (50%), induced emesis in three (37.5%), cathartics in two (25%), and whole bowel irrigation in one medication (12.5%). The strength of recommendation ranged from the suggestion that it "may be indicated" to the advice that all patients undergo aggressive GI decontamination.
Discussion: Of medications frequently reported to be involved in overdoses and fatalities, package inserts frequently recommend the use of GI decontamination. Some of these recommendations may be inappropriate, outdated, or may place patients at risk for adverse events. For example, the package insert for amitriptyline states "all patients suspected of tricyclic antidepressant overdose should receive … large volume gastric lavage followed by activated

charcoal." According to its package insert, in cases of ibuprofen overdose, "the stomach should be emptied by vomiting or lavage."
Conclusion: The package inserts for medications frequently involved in overdose often make recommendations for GI decontamination, some of which do not align with current practice guidelines.

146. Substantial Iatrogenic Fomepizole Overdose Without Associated Adverse Events

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Background: Fomepizole is a competitive inhibitor of alcohol dehydrogenase used in the treatment of ethylene glycol and methanol poisoning. Fomepizole is considered relatively safe, with few adverse events reported in the medical literature at therapeutic doses, although there are no reported cases of fomepizole overdose.
Hypothesis: Fomepizole is well tolerated with few adverse effects, even in substantial overdose.
Methods: Single-patient chart review.
Case: A 61-year-old man was found unresponsive with a container of antifreeze. He was taken to a community emergency department, where he was found to be intoxicated and have a severe metabolic acidosis with elevated anion gap. He was resuscitated with crystalloid, intravenous bicarbonate infusion, and transferred to a tertiary care center. Prior to transfer, he received 6 g of intravenous fomepizole (67 mg/kg) which is significantly higher than the usual 15 mg/kg loading dose. He required 12 h of hemodialysis for his massive ethylene glycol ingestion with initial level of 444 mg/dL, but remained hemodynamically stable without end-organ dysfunction. He was medically cleared for psychiatric disposition on hospital day three. He was noted to exhibit sinus bradycardia, with a heart rate 46 bpm upon arrival and remained in the range of 40–50 bpm throughout his entire hospitalization. Of note, he had a similar heart rate during an unrelated admission months later, making this unlikely to be related to fomepizole. He never developed hypotension and, in fact, was hypertensive on admission (179/70 mmHg).
Discussion: Despite receiving an accidental iatrogenic overdose of fomepizole, this patient did not develop any definitively associable untoward events. This is also the first documented case of fomepizole overdose in a human. Reported adverse events in the literature are rare, are seen with therapeutic use, and primarily include CNS depression and minor cardiovascular disturbances, which were not observed in this patient. Although hypotension has been reported with fomepizole, it was not demonstrated. We could not attribute CNS depression to fomepizole due to confounding effects from ethylene glycol.
Conclusion: Iatrogenic fomepizole overdose was not associated with untoward effects in an adult being treated for ethylene glycol toxicity.

147. Successful Treatment of Acephate Poisoning with Atropine and Pralidoxime

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Background: Organophosphate (OP) poisoning remains a common cause of death from poisoning worldwide, although it is relatively rare in the USA. Atropine and pralidoxime remain the mainstay pharmacologic treatments. However, no studies to date have shown conclusive benefit from the use of pralidoxime. Acephate is a diethyl OP that is widely available as a commercial insecticide. Despite unrestricted access in the USA, there are very few reports of acephate poisoning. In one case, a 4-year-old required ventilation for 18 days following acephate ingestion. Here we present a case of severe OP poisoning from acephate resulting in respiratory failure and neuromuscular toxicity that was successfully treated with atropine and pralidoxime.
Methods: Single-patient chart review.
Case: The patient is a 28-year-old female who presented with abdominal pain and vomiting following an intentional ingestion of an unknown amount of Orthene Fire Ant Killer®, which contains 50% acephate. The patient rapidly developed miosis, depressed mental status, and respiratory distress. Despite atropine and supplemental oxygen, her respiratory rate remained in the 40's and her mental status continued to deteriorate. She developed muscular fasciculations and was intubated for respiratory failure. She was given a bolus of pralidoxime and placed on infusions of both atropine and pralidoxime. Her atropine drip was slowly weaned, and she was extubated on hospital day four. The pralidoxime infusion was continued for 24 h after extubation. Her initial butyrylcholinesterase level was 561 units/L (reference range 2900–7100). Repeat butyrylcholinesterase level drawn around the time of extubation was 2495, nearly within the reference range. She had no return of cholinergic or neuromuscular symptoms following discontinuation of the atropine and pralidoxime infusions. Her hospital course was complicated by *Klebsiella* urinary tract infection, MRSA pneumonia, and *C. difficile* colitis. She was ultimately discharged to a psychiatric facility for further management.
Discussion: Acephate is readily available in the USA, and ingestion can cause significant OP toxicity. This patient had rapid improvement of butyrylcholinesterase levels following treatment with pralidoxime and required mechanical ventilation and atropine infusion for 4 days. This case suggests that pralidoxime was effective in restoring cholinesterase function and decreasing duration of symptoms.

148. ToxIC Extracorporeal Therapies SubRegistry: Update 2017

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Background: Extracorporeal therapies (ECT), such as hemodialysis, are critically important tools in the treatment of poisoned patients. In the last two decades, major changes have occurred in the nature, utilization, and availability of different types of ECT.
Objectives: We aim to characterize and describe the current use of ECT for poisoning, and assist in determining the effectiveness of ECT for various poisonings.
Methods: A prospective cohort study of individuals treated with ECT in the ToxIC ECT subregistry between June 2015 and October 2017 was conducted. A full description of variables recorded in the main and subregistries is available via the ToxIC website http://www.toxicregistry.org.
Results: Thirty-seven cases (46% female; median age 41 years) undergoing 41 types of ECT were reported. Seventy percent underwent hemodialysis, 24% continuous renal replacement; 2% respectively had peritoneal dialysis, plasma exchange, albumin dialysis, extracorporeal membrane oxygenation, slow continuous ultrafiltration, and exchange transfusion. Toxic alcohols, lithium, and salicylates comprised 54% of toxins, and 92% of toxins were at least moderately dialyzable. Most (57%) patients had acute kidney injury (AKI) prior to ECT; 71% of AKI was due to poisoning, and 38% of AKI resolved by hospital discharge. ECT was primarily initiated to remove toxins in 70% of patients, to treat AKI in 14%, and for acidosis in 8% of patients. Two patients experienced complications due to ECT (infection, hypotension). Seventy-eight percent had clinical improvement within 6 h of ECT. Three patients (8%) died during their hospitalization.
Conclusion: ECT is used for many reasons in poisoned patients. While most patients in this series underwent ECT primarily for drug removal, nearly one third underwent ECT for a different primary reason. Most patients had

clinical benefit within 6 h of ECT, and few had complications of therapy. These data suggest a growing role for ECT in poisoning outside of the traditional use of intermittent hemodialysis primarily for drug removal.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

149. Non-Fatal Ingestion of a Potassium Dichromate Solution

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Background: Intentional hexavalent chromium ingestion is exceedingly toxic, with most cases reported in the literature resulting in poor outcomes. Very few case examples depict symptomatic chromium ingestion that does not lead to liver transplantation or death, and little is known about the utility of initial symptoms and chromium levels in predicting outcomes.
Hypothesis: Symptomatic hexavalent chromium ingestion generally leads to severe clinical outcomes.
Methods: Single-patient chart review.
Case: A 15-year-old male ingested two mouthfuls of a solution containing 3 g of potassium dichromate on a dare. He presented several hours later with recurrent orange-colored emesis and diarrhea. Initial workup revealed tachycardia but no other vital sign abnormalities, and no laboratory abnormalities on basic metabolic or hematologic testing. The patient was transferred to a center with liver transplant and exchange transfusion capabilities. He was monitored for about 24 h after ingestion with serial laboratory testing which revealed normal kidney, liver, and hematologic parameters. Initial chromium levels were 343 mcg/L 4 h after ingestion and decreased to 292 micrograms/L 11 h after ingestion. He was discharged home and had no further illness; repeated laboratory tests several days later remained normal.
Conclusion: Not all cases of symptomatic hexavalent chromium ingestion have severe outcomes.

150. Aluminum Neurotoxicity in a Confined-Space Aluminum Welder

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Background: CNS toxicity from aluminum overexposure has mostly been described in the setting of chronic renal failure. Epidemiological studies have found subclinical neurotoxicity associated with occupational aluminum exposure, but overt cases are rare.
Hypothesis: Chronic high-dose aluminum exposure in a confined-space welder resulted in overt central nervous system signs and symptoms.
Methods: Single-patient chart review.
Case: A 62-year-old previously healthy gentleman was referred for 4 years of marked fatigue and difficulty with short-term memory, word-finding, and verbal fluency. An intermittent tremor began 5 years earlier. Four years earlier, he experienced a 15–20% nonvolitional weight loss, hypogeusia, and hyposmia. He had been employed as a welder for 30 years, mainly on aluminum beginning 13 years earlier and almost exclusively within the confined space of aluminum tanks 6 years earlier. After a negative evaluation for nonoccupational causes, his primary care physician obtained a serum aluminum concentration of 68 μg/L (reference range 0–15) 2 years earlier. Renal function was normal. A bone biopsy revealed positive aluminum staining. During 88 courses of chelation with desferrioxamine over 23 months serum aluminum fluctuated between 40 to 70 μg/L, with post-chelation urine aluminum between 750 to 1200 μg/gCr, consistent with an elevated aluminum body burden. Improvements in tremor and verbal fluidity were noted, but fatigue and memory complaints persisted, and neuropsychological examination 14 months after inception of chelation observed relative deficits in attention, memory, processing speed, and executive function. Industrial hygiene data inside the aluminum tanks where the subject welded without respiratory protection or mechanical supplied air included total welding fume exposure as high as 22 mg/m^3 (former ACGIH TLV 5 mg/m^3) and aluminum at least 1.46 mg/m^3 (current ACGIH TLV 1 mg/m^3). The subject's serum aluminum concentrations were more than 10-fold higher than median values reported for aluminum welders in some studies.
Discussion: This welder demonstrated CNS signs and symptoms in association with a history of chronically high confined-space aluminum exposure, and markedly elevated serum and urine measurements. This is a rare case of overt occupational aluminum neurotoxicity in a subject with normal renal function.

151. Concurrent Methemoglobinemia and Pneumonitis after Hydrocarbon Exposure

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Background: There are few hydrocarbons that have been implicated as reducing agents capable of causing methemoglobinemia. More classically these compounds cause a pneumonitis and occasionally cardiac dysrhythmias.
Research Question: Can a hydrocarbon exposure cause methemoglobinemia and pneumonitis in a patient from a single exposure?
Methods: Single-patient chart review of a 2-year-old's exposure to a cyanoacrylate accelerant containing naphtha, hydrotreated heavy petroleum distillates and *N*,*N*-dimethyl-p-toluidine.
Case: The patient drank about 30 mL of a liquid cyanoacrylate accelerant that she found among her father's model airplane manufacturing equipment. She had immediate coughing and a decline in her mental status. EMS brought her to the hospital immediately where she was initially somnolent. Within minutes her mental status improved. However, she developed a low pulse oximetry reading (SPO_2) within 30 min and was transferred to a tertiary referral center on high flow nasal cannula. Upon arrival, she was found to be cyanotic in appearance though not in respiratory distress. Her vitals were normal aside from an SPO_2 of 85%. Her initial methemoglobin percentage was 34.5% with a hemoglobin (Hgb) of 11.8 g (outside hospital HGB 12.5 g). She was given 1 mg/kg of methylene blue, and within 1 h, her SPO_2 was 99% and methemoglobin percentage was 4.1. On the subsequent day the patient developed tachypnea, retractions, tachycardia and hyperthermia to 39.4 C. Her chest x-ray showed bibasilar infiltrates. Her SPO_2 dropped to 94% on high-flow nasal cannula with a repeat methemoglobin percentage of 0.9%. Repeat Hgb on day three was 9.2% with an elevated LDH (262 U/L) and bilirubin (2.0 mg/dL) suggesting intravascular hemolysis. Her respiratory status and Hgb improved, she had no recurrence of methemoglobin, and she was successfully discharged home.
Discussion: This is to our knowledge the first description of concurrent methemoglobinemia and pneumonitis after a hydrocarbon exposure. Cases of methemoglobinemia from 'model air plane glue' are discussed amongst toxicologists, however the actual exposure may be this ubiquitous cyanoacrylate accelerant rather than the glue itself.
Conclusion: Methemoglobinemia and pneumonitis can occur simultaneously from a single exposure to cyanoacrylate accelerant.

152. An Acute Diethylene Glycol Ingestion: Laboratory-Confirmed

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Background: Poisoning from diethylene glycol (DEG) is uncommon, and usually is due to a pharmaceutical diluent substitution though it is commonly used in various industrial products. There are few described DEG-toxic cases in the medical literature due to brake fluid ingestion; these were usually from ethanol substitution or self-harm attempt. There are scarce data on the toxicokinetics of DEG, the mechanism of toxicity has not been clearly elucidated, and the minimum toxic dose has not been established. There appear to be three phases of DEG poisoning in the untreated patient: gastrointestinal symptoms, intoxication, metabolic acidosis followed by permanent renal dysfunction, and finally neurologic complications.
Hypothesis: We present a case of confirmed acute diethylene glycol ingestion with symptoms consistent with the first phase of toxicity with complete recovery following hemodialysis.
Methods: Single-patient chart review.
Case: A 58-year-old female presented to a rural emergency department with lethargy and inebriation. She admitted to drinking ZECOL DOT 3 brake fluid and was brought to the hospital. She arrived 5 h post-ingestion. Initial labs were remarkable for a pH 7.34, anion gap 18, and a minimal serum ethanol level. She was started on fomepizole immediately and transferred to a hemodialysis-capable hospital. Upon presentation, 10 h after ingestion, labs were unchanged. Remarkable toxic alcohol labs were serum acetone 34 mg/dL, propyl glycol 6 mg/dL, and negative levels for ethylene glycol, isopropanol, methanol. At 15 h post-ingestion and 9 h post-fomepizole, labs were pH 7.37, anion gap 21, normal renal glomerular flow rate, and diethylene glycol 13 mg/dL. Hemodialysis was initiated for 4 h. Repeat serial labs were without signs of acidosis or renal dysfunction. Serum diethylene glycol was undetectable at 48 h post-ingestion and 24 h post-hemodialysis. After hemodialysis, patient's mental status improved, and she admitted to drinking an estimated maximal ingestion of 120–240 mlL. She drank brake fluid to self-treat alcohol withdrawal symptoms.
Conclusion: We present a case of acute diethylene glycol ingestion with a known time of ingestion, amount of ingestion, and serum diethylene glycol levels pre- and post-hemodialysis. This case contributes to the scarcity of data regarding human diethylene glycol ingestion.

153. Repeated Acute Large Volume Ingestions of Lead Pellets in an Adult

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Background: Acute lead ingestion is commonly associated with pediatric patients, with little evidence-based recommendations for treatment during ongoing gastrointestinal (GI) exposure in adults. We present a case of repeated lead pellet ingestions managed with whole bowel irrigation (WBI) and endoscopy, but not chelation therapy.
Methods: Single-patient chart review.
Case Report: A 32-year-old woman presented to an emergency department (ED) after ingesting metallic pellets found in a convenience store beverage. Radiographs showed numerous radio-opaque foreign bodies (FBs) in the GI tract. Whole blood lead level (BLL) was 42mcg/dL and she was discharged with outpatient follow-up. Eight days later, she returned to the same ED after a second ingestion of metallic shavings in another convenience store beverage. Repeat radiographs showed increased abdominal FBs and she was transferred to our facility. She was well-appearing but reported nausea and chronic headache. Vital signs included Temp. 36.6 °C, HR 81 bpm, BP 112/74 mmHg, and SpO_2 of 99% on RA. Abdominal and neurologic examinations were normal. She denied intentional ingestion. Repeat BLL on hospital day (HD) 1 was 50.2 μg/dL. Zinc protoporphyrin level was normal at 80 mcg/dL. Hemoglobin was 12.6 g/dL, mean corpuscular volume was 90 fL, and creatinine was 0.65 mg/dL. Intermittent WBI was used unsuccessfully for 72 h. On HD 4, most of the FBs were removed via endoscopy. Nausea and abdominal pain resolved and she was discharged on HD 5. One month post-discharge, BLL was 34.1 mcg/dL and abdominal radiographs showed only three remaining FBs. The foreign bodies were evaluated and found to contain 2.2% lead.
Discussion: This patient was treated with WBI and endoscopy to reduce the FB burden but without chelation due to lack of systemic toxicity and concerns for possible increased absorption of lead. Initial management of patients with heavy metal poisoning must involve termination of the exposure, and limited data are conflicting in terms of oral chelation causing increased absorption. For ingestions, efforts should focus on GI decontamination and decreased transit time.
Conclusion: Chelation therapy should be reserved for significant clinical effects (e.g., encephalopathy) and the risks and benefits of oral chelation therapy during ongoing GI exposure require more investigation.

154. What Is the Optimal Technique for Removal of Cyanoacrylate Glue?

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Background: A recent poison control center-based study showed wide variability in recommendations for removal of cyanoacrylate from skin. There is a paucity of literature on the optimal removal technique. No controlled trials exist comparing the multiple different suggested techniques for removing cyanoacrylate from skin.
Hypothesis: Acetone, mineral oil, antibiotic ointment, or WD-40® will show a lower separation force compared to untreated cyanoacrylate.
Methods: Two 3 × 11 cm strips of leather were attached together with 3 cm of overlap by a 0.5-cm diameter dot of cyanoacrylate gel. All strips were dried for 24 h. Varying solvents were applied to the glued area for 5 min, and an Instron forcemeter was used to measure the amount of shear force, in Newtons (N), required to separate the glued strips. Five different groups of five strip pairs each were measured: (1) control (no solvent); (2) acetone; (3) mineral oil; (4) topical antibiotic ointment; (5) WD-40®. A Kruskal-Wallis test was used to analyze differences between groups.
Results: The median (25th, 75th percentile) force (in N) required to separate the test strips was as follows: (1) control, 351.1 (295.8, 394.2); (2) acetone, 291.2 (206.9, 561.6); (3) mineral oil, 646.4 (573.4, 720.0); (4) topical antibiotic ointment, 503.0 (446.7, 739.1); (5) WD-40®, 524.5 (327.5, 675.7). No significant differences were seen between medians of the samples tested (p = NS, chi-square).
Discussion: There were no statistical differences between the groups; this may be due to several factors. It was noted on visual inspection of the failure points that none of the chemicals had penetrated to the center of the dried cyanoacrylate; this likely limited the solvents' effect on the bond. Significant variability in failure forces was noted within each set; this may in part be due to small variability in the amount of cyanoacrylate and area over which it was spread, and variations in the leather. This was a pilot study with a limited number of samples; a larger data set might show differences between removal techniques.
Conclusion: In this pilot study, no significant differences were noted between the four measured techniques for cyanoacrylate removal.

155. Lead Toxicity in a Patient Due to Retained Bullet Fragments

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Background: Lead toxicity is rarely seen with retained bullet fragments due to sequestration in soft tissue which prevents systemic absorption. We describe a patient with retained bullet fragments and elevated lead levels who developed symptoms 4 years after the original gunshot wound.

Methods: Single-patient chart review.
Case: A 27-year-old male with retained bullet fragments in his left leg from a gunshot wound sustained in 2013 presented to the emergency department with 2 weeks of worsening left knee pain and swelling in conjunction with intermittent, dull, spasmodic, epigastric abdominal pain associated with occasional emesis. He denied prior illness or sick contacts. Vital signs were normal. Physical exam was notable for a 10 cm × 8 cm fluctuant mass without evidence of cellulitis. X-ray of the left knee showed myositis ossificans measuring 14.4 × 8.5 × 8.0 cm containing metallic bullet fragments adjacent to the distal femur. Lab work revealed a hemoglobin 12.5 g/dL, MCV 86.1, lead level 92.6 μg/dL, and zinc protoporphyrin 479 μmol/mol heme. Alternative sources for his elevated lead level were ruled out. The mass and most bullet fragments were excised. Pathology confirmed a large fluid-filled mass with extensive wall calcification and fragments of foreign material with associated foreign body giant cell reaction. Repeat lead level on post-operative day one was 68 μg/dL. Due to the rapidity of the decline in his lead level, the patient was not chelated. The patient signed out against medical advice on postoperative day two and was lost to follow-up.
Discussion: Absorption of inorganic lead via soft tissue is generally minimal and slow, but is dependent on size, surface area, and location. Inflammatory reactions that result in fluid collections may increase absorption. Treatment of chronic lead toxicity is primarily focused on removal from the exposure, which in our patient's case entailed removal of the retained bullet fragments. If the source can be identified and removed, chelation is often not necessary.
Conclusion: Physicians should be aware that stable foreign bodies may undergo changes that lead to increased heavy metal absorption and systemic toxicity.

156. Aluminum Toxicity Following Sucralfate Administration in Two Patients with Chronic Renal Disease

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Background: Sucralfate, a medication used to treat peptic ulcers, is metabolized in the gastrointestinal tract and excreted in the urine. During this process, aluminum is freed from the complex and can be absorbed systemically.
Hypothesis: Patients with chronic renal disease have increased risk of aluminum accumulation and toxicity following sucralfate administration.
Methods: This is a chart review of two patients.
Cases: First, a 67-year-old male with complex history including end-stage renal disease on hemodialysis, atrial fibrillation, and dementia was admitted for recurrent lethargy and confusion. His mental status initially changed when metoclopramide and sucralfate were added to his medication regimen. On admission, basic lab studies were drawn along with thyroid and parathyroid hormone levels, an arterial blood gas, and a serum aluminum concentration of 117 mcg/L. Patient was then given deferoxamine prior to dialysis during hospitalization. The second patient was a 39-year-old male with history of C2 quadriplegia, diabetes mellitus, and chronic kidney disease with suprapubic catheter who presented with an episode concerning for seizure following a week of decreased interaction. He was also taking sucralfate, which was held after admission. Neurotelemetry was initiated and aluminum concentration was found to be 46 mcg/L. In the first case, sucralfate was discontinued and the patient was treated with deferoxamine at 5 mg/kg based on a treatment protocol from Barata, JD et al. in 1996. Follow-up aluminum concentrations at 2 and 6 months were 42 and 23 mcg/L, respectively. In the second case, sucralfate was also held and repeat concentration 3 days later was 16 mcg/L.
Discussion: Previous studies have shown contradictory evidence as to whether or not sucralfate appreciably increases aluminum accumulation in patients. Here we present two cases of significant aluminum toxicity in patients with chronic renal disease.
Conclusion: Additional monitoring may be necessary when administering sucralfate to patients with chronic renal disease to minimize the risk of aluminum accumulation and toxicity.

157. Epidemiology of Amyl Nitrite Exposures Reported to the National Poison Data System from 2000 to 2015

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Background: Abuse of nitrites, often referred to as "poppers," has increased per the lay media. Our study researches the epidemiological trends in US Poison Control Centers (PCs) nitrite exposure calls.
Methods: We retrospectively queried the National Poison Data System (NPDS) for amyl and butyl nitrite exposures from 2000 to 2015, as specified by the AAPCC generic code 034810. The nitrite exposure calls, including those reporting intentional exposures, were analyzed to examine annual trends. Calls reporting amyl nitrite therapy were excluded. Patient characteristics were descriptively assessed. Trends in the exposure to nitrites during the study period were analyzed using Poisson regression.
Results: There were 1365 exposures to amyl or butyl nitrites during the study period with 55.8% being intentional exposures. Single-agent nitrite exposures were found in 79.3 and 72.8% of the overall and intentional exposure calls, respectively. Among the total calls received, 3% were reported as suicide attempts while abuse was cited in 44.6% of cases. Within the calls for intentional exposures, 5.4% were suicide attempts while 80.1% were cases of abuse. The number of overall cases reporting an exposure increased from 75 calls in 2000 to 132 calls in 2015, an increase of 76%, with intentional exposures also demonstrating an increase (34 to 81). Demographically, adults within the age group 20–39 years (46.3%) and males (87.9%) were at a greater risk of intentional exposure. The principal routes of administration with intentional exposure were ingestion (47.3%) and inhalation (48.8%). Among the intentional exposure cases, 58.9% were en route to the healthcare facility. Major clinical effects (8.3%) among intentional exposures were infrequent. Regression analysis demonstrated an increasing trend in intentional exposures corresponding with a rate of 3.1 additional exposures each year [95% CI 2.1–4.1; $p = <$ 0.001]. Overall, the number of calls increased by 3.8 additional calls per year [95% CI 1.8–5.8; $p = 0.0002$].
Conclusions: This study demonstrated a gradual rise in the rate of PC nitrite exposure cases, both intentional as well as unintentional. Although not severe, such exposures were seen more commonly seen in adult males and can pose a potential risk to people who misuse these substances.

158. Pediatric Toxicities to Acetaminophen Reported to the US Poison Centers 2011–2016.

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Background: Acetaminophen is a widely used medication and readily available in society. We sought to analyze the pediatric trends and characteristics of acetaminophen exposures reported to the US Poison Centers (PCs).
Methods: We retrospectively identified all pediatric exposures to acetaminophen reported to the National Poison Data System (NPDS) from 2011 to 2016, using the AAPCC generic codes for single and combination acetaminophen products. We descriptively assessed the distributions of several key characteristics of the exposures. Trends in the pediatric acetaminophen exposures per 100,000 pediatric exposures (PE) during the study period were analyzed using Poisson Regression.
Results: Nationally, the number of pediatric acetaminophen exposures (360,785) reported to the US PCs, decreased from 66,736 in 2011 to

55,597 in 2016, at a percentage change of 16.7%. Single-substance exposures accounted for 82.1% of the calls with benzodiazepines and naproxen being the most common co-occurring substances. Acetaminophen-only products accounted for 78.1% of the exposures. Unintentional exposures (74.5%) were responsible for the majority of the cases, with therapeutic errors accounting for 21.1% of the exposures. Among the intentional exposure cases, 18.9% reported the use of combination acetaminophen products. The most frequent age groups included children ≤ 5 years (65.2%), followed by ages 6–12 years (34.5%). Females comprised 55.5% of the cases. Of the total pediatric acetaminophen exposures, 16.4% were admitted to a healthcare facility and 19.2% were treated by a health professional and released to home. There were 62 pediatric deaths due to acetaminophen toxicity reported during the study period, with 42 deaths attributed to combination acetaminophen products. The most frequent clinical effects reported included drowsiness/lethargy, vomiting, and nausea. Intravenous *N*-acetylcysteine was used in 7.5% of cases. During the study period, the rates of acetaminophen per 100,000 pediatric exposures decreased by 7.6% ($p < 0.001$).
Conclusions: Our study demonstrated a decline in acetaminophen exposure calls to US PCs in the pediatric population. Exposures to acetaminophen continue to be one of the most commonly reported to poison centers. The majority of such exposures are due to unintentional and therapeutic errors. A significant number of pediatric exposures are admitted to a healthcare facility.

159. Lamotrigine ODT-Induced Seizure in a 3-Year-Old Child After Accidental Ingestion: a Case Report

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Background: Lamotrigine is a new-generation antiepileptic, which works via blockade of sodium channels. A case report of a child with the highest reported serum lamotrigine concentration who developed a seizure and respiratory failure is presented.
Methods: Single-patient chart review.
Case: A somnolent 3-year-old child requiring BVM ventilation was transported to the ED by EMS after presumptively ingesting 7–16, 25 mg lamotrigine disintegrating tablets and 1–6 0.5 mg tablets of clonazepam. Upon arrival the patient suffered a generalized tonic-clonic seizure that terminated after 1 mg IO lorazepam. The patient was endotracheally intubated and admitted to the PICU. EKG revealed normal sinus rhythm at 95 bpm and normal intervals. Serum lamotrigine concentration measured 23.2 and 18.5 mcg/mL at approximately 3 and 24 h after ingestion, respectively. A comprehensive metabolic panel was within normal limits. Urine drug screen, serum acetaminophen, serum salicylate, and serum alcohol levels were not obtained. Serum LC/MS toxicology screen ~ 24 h after ingestion detected acetaminophen, lamotrigine, 7-aminoclonazepam, midazolam, alpha-hydroxymidazolam, and lorazepam. Patient was administered lorazepam, midazolam, and acetaminophen during hospitalization. The patient was extubated on HD 2 and discharged on HD 5 without sequelae.
Discussion: Six case reports of acute, pediatric lamotrigine poisoning were identified upon literature review. The maximum potential dose of lamotrigine this patient could have ingested was 27.6 mg/kg, the lowest reported acute dose causing a seizure in a pediatric patient (previously reported 43 mg/kg). Moreover, this patient seized despite confirmed co-ingestion of clonazepam.
Conclusion: Lamotrigine toxicity can cause somnolence, seizures, and hyperkinetic/ataxic activity. Treatment remains supportive with attention to cardiac sodium channel effects and seizures treated with sodium bicarbonate and GABA agonists, respectively.

160. A Retrospective Review of Pediatric Lamotrigine Ingestions Reported to a Poison Center

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Background: Lamotrigine has an established role in the management of epilepsy and is increasingly being used as a mood stabilizer in the treatment of bipolar disorder. There is little information regarding unintentional ingestions of lamotrigine in young children and what doses are likely to be a problem.
Methods: This was a 6-year retrospective study of pediatric (< 6 years old) lamotrigine mono-ingestions reported to the Oregon Poison Center from 2010 to 2016. Case notes were reviewed to collect information on exposure and clinical course.
Results: One hundred cases met inclusion criteria with 63% male patients and mean age of 2.1 years (range, 8 months–5 years). The lamotrigine dose ingested (mg/kg) was reported in 49 cases and categorized based on reported certainty of ingestion (exact, estimated, and maximum). Nine cases had an "exact" mg/kg amount of lamotrigine ingested (median dose, 3.5 mg/kg; range, 2.9–11 mg/kg). In those cases that the dose was known, no association was evident between the ingested dose and development of symptoms. Of all patients, 75 patients had no effect from the drug exposure. Specific adverse effects were reported in 25 patients. The most common effects reported were drowsiness/lethargy ($n = 14$), ataxia ($n = 11$), nausea/vomiting ($n = 7$), tremor ($n = 4$), nystagmus ($n = 3$), and agitation (n = 3). Seizures were reported in only two cases. Forty-nine patients were observed at home, 37 were treated and released from the emergency department, and 14 were admitted. Medical outcome was considered mild in 18 patients, and moderate in seven with no reported major outcomes or fatalities. Treatments included a single dose of activated charcoal in ($n = 6$), intravenous fluids ($n = 4$), and anti-emetics ($n = 1$).
Conclusions: The majority of pediatric lamotrigine-only exposures developed no toxicity. The most common adverse effects reported were neurological. No child had more than a moderate outcome, and there were no fatalities. All patients recovered quickly with routine supportive care. We were unable to determine what constitutes a significant dose from the data. However, based on this data, it appears that our poison center may be referring more children to health care facilities for these exposures than is necessary.

161. Reproductive Environmental Health Concerns Reported to the Pediatric Environmental Health Specialty Unit Program

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Background: A recent American Congress of Obstetricians and Gynecologists (ACOG) committee opinion called for better education of reproductive providers on environmental health issues. In 2015, the Pediatric Environmental Health Specialty Unit program (PEHSU) was expanded to include reproductive consults. The PEHSU program is divided into 10 regional sites that perform telephone consults regarding pediatric environmental and reproductive health information.
Hypothesis: Analysis of the PEHSU consult records can help identify environmental health concerns associated with pregnancy.
Methods: REDCap, a web-based application platform, was used to collect information on the PEHSU reproductive consults. Information that was collected included age of patient, gestational age, potential exposure occurrence, site of exposure, and type of exposure. Reports on reproductive consults between January 2016 and September 2017 were then analyzed.

Results: As of September 30, 2017, there were 58 reproductive consults. Consult records were from all 10 regions and from 15 different states. There were 26 consults to health professionals and 32 consults to the public. Median age of pregnant women was 32 years. Gestational age: 23% first trimester, 31% second trimester, and 26% third trimester. Thirty-nine of 58 records (67%) noted a potential exposure had occurred. Of the potential exposures, 62% occurred in home, while others include exposure in work (15%), schools (3%), and daycare settings (3%). The most frequent agents of concern for a potential exposure consults were lead (23%), mercury (15%), fungus and mold (10%), marijuana (8%), and cleaning/disinfectant products (5%). Other agents of concern include carbon monoxide, copper, indoor air contaminants, water toxins, formaldehyde, pesticides, volatile organic compounds, and perfluorinated compounds.
Conclusion: PEHSU tracking system can identify a variety of toxic concerns in pregnant patients. Developing anticipatory educational tools, such as the forthcoming ATSDR/ACMT Prenatal Assessment of Environmental Risk tool, may help better address these concerns.

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162. The Pediatric Environmental Health Specialty Unit (PEHSU) Consult Program

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Background: The Pediatric Environmental Health Specialty Unit (PEHSU) program supports a network of ten pediatric environmental health (PEH) centers that provide telephone consults to health professionals and the public.
Research Question: Consults provided by the PEHSU network of PEH specialists offer a unique insight into the concerns of health professionals and the public regarding potential toxic exposures to children and women of reproductive age.
Methods: PEHSU specialists maintain deidentified consult records in a national Performance Tracking System. We analyzed all individual consults initiated between January 2016 and September 2017 in which a potential exposure occurred.
Results: With 1201 consults, potential exposures impacting children or families were addressed. Seven hundred eighteen (59.8%) were provided to health professionals and 483 (40.2%) to the public. In 927 (77.4%) cases, the primary reason for the consult was a request for information about a specific potential exposure or health problem. Another 125 (10.4%) requested referral to a PEH specialist. These consults involved 1355 children (median age 4) of which 610 were male, 526 female, 178 gender unknown, and 307 women (39 disclosed pregnancy). The five most frequently noted primary agents or health issues of concern were lead (506, 42.2%), asthma (106, 8.8%), fungus/mold (77, 6.4%), drugs (64, 5.3%), and pesticides (41, 3.4%). Of the 711 (59.2%) consults in which the potential exposure setting was known, 621 (87.3%) occurred in the home, 21 (3.0%) in schools, 12 (1.7%) in daycares, 11 (1.5%) at work, 4 (0.6%) from a waste site or landfill, and 34 (4.8%) other.
Of the 661 (55.0%) consults provided to first-time PEHSU callers, 260 (41.4%) were referred from health care providers, 56 (8.9%) from Poison Centers, 46 (7.3%) from state/local health departments, 41 (6.5%) from PEHSU staff, and 35 (5.6%) from PEHSU national/regional websites. Remaining callers were referred from other agencies or contacts.
Discussion: Lead, asthma, and mold were the primary subjects of inquiry to PEHSUs. Young children and pregnant women continue to be the focus of PEHSU consults involving potential exposures.
Conclusion: Telephone consults provided by PEHSU experts provide a unique insight into PEH concerns of health professionals and families.

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163. Types of Cases Referred by Poison Centers to the Pediatric Environmental Health Specialty Unit Program

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Background: The Poison Center system has provided consults on millions of toxic exposures since the first Poison Center was established in 1953. In 1998, the Pediatric Environmental Health Specialty Unit (PEHSU) program was established, which also provides telephone consults on toxic exposures, particularly in children and (recently) in pregnant women. Some PEHSU consults are actually referred from Poison Centers.
Research Question: Describe PEHSU consults to callers referred from Poison Centers.
Methods: PEHSU specialists maintain consult records in a national Performance Tracking System. Each first-time caller to a PEHSU is asked how they were referred to PEHSU. We analyzed PEHSU consults initiated between January 2016 and September 2017 that were referred from Poison Centers.
Results: Between January 2016 and September 2017, the PEHSU program performed 1312 consults to first-time callers. Eighty (6.1%) of these callers were referred to PEHSU from Poison Centers. Of these 80 Poison Center referral cases, 52 (65.0%) consults were provided to health professionals and 28 (35.0%) to the public. In 78 consults (97.5%), the primary reason for the call was to request information related to a specific potential exposure or health problem. In 26 cases (32.5%), the primary agent/health problem prompting the consult was lead, followed by drugs 14 (17.5%), fungus/mold 6 (7.5%), cleaning/disinfectant products 3 (3.8%), mercury 3 (3.8%), natural gas 3 (3.8%), and perfluorinated chemicals (PFCs) 2 (2.5%). Other Poison Center referrals to PEHSUs involved aluminum polish, anemia, artificial turf cooling pellets, bath salts, carbon monoxide, coal tar, cobalt, developmental delay, electromagnetic fields (EMF), grain alcohol (ethanol), gases/fumes, metals (general), nicotine gum, polyurethane, Red Bull beverage, smoke/combustion products, vitamin D, volatile organic compounds (VOCs), and water toxins. In four cases (5.0%), the agent was unknown.

Discussion: On occasion, Poison Centers will refer cases to the PEHSUs for further evaluation. PEHSU expertise in pediatric and reproductive environmental health provides another resource for Poison Centers.
Conclusion: Poison Centers refer callers to PEHSUs on a variety of potential toxic environmental exposures and health concerns.

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164. QT for Cuties: ECG Monitoring in Pediatric Exploratory Ingestion of QT-Prolonging Drugs

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Background: Poison centers (PCs) are frequently called by health care facilities (HCFs) about pediatric exploratory ingestions (PEIs) involving drugs with potential for QT prolongation. However, the incidence of conduction abnormalities following PEI appears to be low and the optimal approach to ECG monitoring is unclear.
Research Question: Does the ECG provide useful information in minimally symptomatic children following PEI?
Methods: The regional PC database was searched for suspected ingestions by children ≤ 6 years old involving 28 QT-prolonging drugs from 2005 through 2016. We reviewed case narratives, recording age, substances involved, symptoms, whether the PC recommended one or serial ECGs, presence of conduction abnormalities, and medical outcome. Cases involving multiple substances and those not followed to a known medical outcome were excluded.
Results: The initial database search yielded 1087 cases. Four hundred three met exclusion criteria leaving 684 considered for analysis. Median age was 2 (IQR 1.7–3) years. 53.6% were male. The most frequently involved drugs were diphenhydramine ($n = 346$) followed by neuroleptics (210), cyclic antidepressants (41), SSRIs (37), and antidysrhythmics (8). The most frequent medical outcome was no effect ($n = 360$, 52.6%), followed by minor (251, 36.7%), moderate (71, 10.4%), and major (2, 0.3%) effects. There were no fatalities. The two patients with major effects had CNS depression due to risperidone and methadone (treated with naloxone infusion). Neither required endotracheal intubation, vasopressor support, or had QT prolongation. The PC specialist recommended an ECG in 344 cases (50.3%), though in 30 cases, this was recommended only if the child became symptomatic. Serial ECGs were recommended in 29 cases (4.2%). An ECG was performed in 399 cases; QTc prolongation was noted in three (470, 490, and 513 milliseconds), all of whom were symptomatic with mental status changes. Agents involved in these three cases were olanzapine, risperidone, and clozapine, respectively. QTc prolongation subsequently improved. There were no dysrhythmias.
Discussion: Among 399 children who had ECGs after suspected PEI of QT-prolonging drugs, 3 (0.8%) had QTc > 460 and 1 (0.3%) had QTc > 500, and no dysrhythmias were documented.
Conclusions: ECGs are unlikely to change management in minimally symptomatic children with suspected exploratory ingestion.

165. Sex Differences in Pediatric Poisonings: an Analysis of the Toxicology Investigators Consortium (ToxIC) Registry: 2010–2016.

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Background: Previously reported sex differences in pediatric poisonings include a male predominance in accidental ingestions and a female predominance in intentional poisonings.
Hypothesis: The study aim was to review sex differences among ToxIC pediatric poisonings.
Methods: Pediatric cases between 1/2010–12/2016 were reviewed. Cases with missing data were excluded from the analysis. Descriptive statistics, chi-square tests and logistic regression were used to assess differences in distribution of study variables by sex. All analyses were performed with Stata SEv14.2. Study was exempted from IRB review.
Results: Among a total of 51,441 cases, 542 (1.05%) were excluded for missing data; 13,836 were pediatric cases: 13.1% ($n = 1818$) were < 2 years, 18.0% ($n = 2496$) were 2–6 years, 8.8% ($n = 1212$) were 7–12 years, and 60.1% ($n = 8310$) were 13–18 years of age. 58.2%, $n = 8057$ were females. 49.5% were intentional pharmaceutical exposures: females were more likely (OR = 3.3; 95% CI 3.1–3.6) than males to be managed for this exposure. Males were more commonly (OR = 2.0; 95% CI 1.8–2.2) managed for intentional non-pharmaceuticals. Analgesics/opioids cases were most common: 22.7% of cases; females were more likely (OR = 2.5; 95% CI 2.3–2.7) than males to be treated for this exposure. Males were 1.7 times more likely than females (OR = 1.7; 95% CI 1.4–2.0) to be treated for sympathomimetics. 86.1% of cases were oral ingestions. Females were more likely to present with oral ingestion (89.8% versus 80.3%, $p < 0.001$); males were more likely to present with inhalation (5.5 versus 1.6%. $p < 0.001$). Only 18.1% of cases had abnormal vitals: tachycardia was most common (9.2%), with no difference in presenting signs by sex. No medical intervention was recorded in 77.9% of cases. Pharmaceutical support was given in 16.0%, intubation/mechanical ventilation in 6.0%, and ECMO in 0.1%. No significant differences in treatment intervention were observed by sex. Twenty-four females (0.17% of pediatric cases) and 21 males (0.15% of pediatric cases) died.
Discussion: Sex differences in pediatric poisonings included a predominance of intentional pharmaceutical exposures and oral ingestions among females and intentional non-pharmaceutical exposures and inhalant exposures in males.
Conclusions: Sex-based differences observed in pediatric poisonings have implications for education and prevention efforts.

This research was performed in collaboration with the ACMT Toxicology Investigators Consortium.

166. Medical Toxicology Beside Consultation Provides Enhanced Clearance Compared to Poison Center-Based Protocols in Pediatric Antidepressant Ingestions

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Background: In the USA, poisoning and drug ingestion represent a significant public health concern. Poison Centers (PCs) are typically the first point of contact for these patients and have been instrumental in reducing unnecessary costs and emergency department (ED) visits. Medical toxicology bedside care is provided primarily via a consultation model in the USA, although a few admitting services exist. Improvements in length of stay, reduced healthcare costs and reduction in mortality have been shown when comparing medical toxicology admission service to non-toxicologist care in poisonings. Despite this, there are relatively few places around the country that provide direct medical toxicology support, whereas nearly all hospitals have access to poison center guidance.
Research Question: To investigate whether direct bedside consultation by a medical toxicologist improves upon specific recommendations or protocol-based care provided via remote Poison Center involvement for time to clearance in pediatric antidepressant ingestions presenting to an ED.
Methods: Retrospective cohort study involving pediatric patients (0–18) that presented to an urban, tertiary-care pediatric ED for antidepressant ingestion from 1/2011 to 6/30/2016. All patients were seen bedside by a board-certified medical toxicologist. Recommendations were compared for time to clearance and number of interventions for medical toxicology direct bedside care to Poison Center (PC) involvement. Statistical analysis included Mann-Whitney *U* test and chi-square to calculate comparison and differences in clearance times and number of interventions respectively.
Results: 136 pediatric patients with a primary drug antidepressant ingestion had medical toxicology consultation performed during the period studied. On average, clearance time per patient was shorter by 4.95 h for toxicology recommendations compared to actual and protocol-based PC clearance times ($p < 0.001$). Patients also had fewer number of interventions (mean difference of 0.29) recommended with medical toxicology consultation although this was not significant (p value 0.14).
Conclusion: Direct bedside consultation for pediatric antidepressant ingestion managed by a board-certified medical toxicologist provided quicker clearance times than remote PC involvement and protocol-based care. We suggest a collaborative model be studied in which bedside medical toxicology service complements PC-based prehospital triage. This model may apply to a variety of ingestions.

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167. Altered Mental Status Due to Accidental Ingestion of 5F-ADB in a Pediatric Patient

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Background: Synthetic cannabinoid receptor antagonists (SCRA) are an emerging drug of abuse, often marketed as "legal highs," although reports of acute ingestions are rare, especially in the pediatric population. Newer agents in this class, including 5F-ADB, are characterized by high affinities for the CB1 and CB2 receptors.
Hypothesis: Laboratory-confirmed 5F-ADB ingestion in a pediatric patient was associated with sedation requiring hospital admission.
Methods: Single-patient chart review.
Case: A 16-month-old female child presented to an emergency department after licking a paper reported to have "liquid K2" on it 8 h prior. She exhibited sedation without respiratory depression. Per outside hospital reports, her vital signs were "normal." She was transferred to a tertiary pediatric facility for further evaluation. There, approximately 16 h after exposure, her mental status had returned to baseline. She was found to have a low serum bicarbonate (20 mEq/L), but no other metabolic or hematologic abnormalities. She required no further medical intervention. On urine gas chromatography/mass spectrometry, a detectable amount of ecgonine methyl ester, a cocaine metabolite, was identified, although her urine EMIT drug screen was below the detection threshold for all tested substances, including cocaine. Urine high-performance liquid chromatography/tandem mass spectrometry (LC-MS/MS) identified 5F-ADB 3,3-dimethyl-butanoic acid. Based on known metabolism of similar SCRAs, this compound is a metabolite of 5F-ADB.
Discussion: The association between the exposure to a purported synthetic cannabinoid-containing product, the subsequent sedation, and the discovery of a proposed metabolite of 5F-ADB metabolism suggests the patient's condition is secondary to ingestion of 5F-ADB or a related compound. The relatively short duration of sedation is consistent with what has been reported with other SCRA exposures. The presence of cocaine metabolite in her urine is of unknown importance, although no benzoylecgonine was discovered, explaining the lack of positive EMIT testing.
Conclusion: We present a laboratory-confirmed exposure to 5F-ADB causing altered mental status in a pediatric patient to add to the corpus of literature concerning SCRA exposures.

168. Unintentional Ethylene Glycol Exposures: Pediatric Pearls in Management

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Background: Unintentional pediatric ethylene glycol (EG) ingestions can be problematic. Confirmatory testing may be difficult to obtain, and management challenges and disposition decisions add to this dilemma.
Study Objective: To characterize and compare unintentional EG ingestions in children with older patients.
Methods: Electronic regional poison center (RPC) records were retrospectively queried for EG exposures over a 14-year period (2003–2016). Inclusion criteria were unintentional exposures with confirmatory concentrations reported. Two trained reviewers abstracted demographics, EG concentrations, admissions, transfers, treatments, and outcomes. Patients were divided into two groups: group 1 ≤ 6 years and group 2 > 6 years.
Results: A total of 113 patients met inclusion criteria with 45 patients in group 1 and 68 in group 2. Kappa was 0.8. Average age was 2.5 years, with 30 males and 15 females in group 1. Average age was 35 years, with 53 males and 15 females in group 2. Four patients (9%) had detectable concentrations in group 1 (highest 14.9 mg/dL) versus 21 (31%) in group 2 (highest 419 mg/dL). Eleven (24%) patients were admitted in group 1 and 29 (43%) in group 2. Transfer to a higher level of care occurred in 17 (37%) patients in group 1 but only five (7%) in group 2. Fomepizole was administered to 31 (69%) patients in group 1 and 45 (66%) in group 2. Two (4% group 1, 3% group 2) patients in each group received ethanol. No patients in group 1 underwent hemodialysis, whereas nine (13%) in group 2 did. All patients in group 1 had either no effect (39) or minor effect (6). Group 2 outcomes were more serious overall: 33 no effect, 20 minor effect, 12 moderate effect, 3 major effect, and 0 death.

Discussion: Unintentional EG ingestions differ with age. Patients in group 1 received fomepizole more frequently and were transferred despite no patients having concentrations warranting therapy. Hemodialysis was only required in group 2 and these patients had more serious outcomes.
Conclusion: Fourteen years of unintentional pediatric EG ingestions from our RPC did not result in clinically significant EG elevations compared to older patients.

169. Respiratory Depression Requiring Mechanical Ventilation in a Pediatric Ondansetron Overdose

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Background: Ondansetron is a commonly prescribed 5-HT_3 receptor antagonist antiemetic agent. It is typically associated with few adverse drug events. We report two cases of respiratory depression requiring intubation and ventilation following large pediatric ondansetron ingestions.
Methods: Chart review of two pediatric patients.
Cases: A 4-year-old female presented to the emergency department with acute ataxia, central nervous system depression, abnormal speech, and loss of balance after ingesting 4 mg tablets of her mother's ondansetron. Presenting vital signs were heart rate 147 bpm and blood pressure 117/74 mmHg. The patient had flushed skin, dilated pupils, and was hypoxic at 91%. She was intubated an hour after arrival. Laboratory studies demonstrated normal electrolytes and negative urine drug screen. Electrocardiogram demonstrated sinus tachycardia with QRS of 60 ms and QTc of 450 ms. Urine drugs of abuse screen was negative. Urine GC/MS was significant only for metabolites of ondansetron. After 7.5 h of ventilator support, she had returned to her neurologic baseline and was extubated.
A 2-year-old female presented to the emergency department following generalized tonic-clonic seizure-like activity that improved with administration of 1 mg lorazepam. She had ingested five to six 4 mg disintegrating ondansetron tablets (20–24 mg). Presenting vital signs included a temperature of 36.9 °C, respiratory rate of 12 bpm, heart rate of 154 bpm, blood pressure of 92/41 mmHg, and saturating 77% on room air. She was intubated due to hypoxia. Laboratory studies included normal electrolytes, CBC, and negative urine and serum drug screens. Urine GC/MS revealed metabolites of ondansetron and caffeine. Patient had an EEG performed along with a CT scan which were both negative. Patient remained intubated for 9 h and was subsequently extubated and noted to be at baseline.
Discussion: Though typically considered a rather innocuous ingestion, there have been previous case reports of ondansetron toxicity describing seizures, depressed mental status, myoclonus, QT prolongation, and, rarely, serotonin syndrome that usually occurs from combination with other serotonergic agents.
Conclusion: Our cases demonstrate that significant respiratory depression requiring mechanical ventilation following ondansetron ingestion in a pediatric patient is possible.

170. Thousand-Fold Oral Vitamin K Dosing Error in a Newborn

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Background: The American Academy of Pediatrics recommends 0.5–1 mg intramuscular (IM) vitamin K1 as prophylaxis against vitamin K deficiency bleeding (VKDB) of the newborn. One alternative for VKDB prophylaxis is oral vitamin K. The most common dosing is a 3-dose regimen of 1–2 mg on day of life (DOL) 1, 4–10, and 28–42. A toxic dose of oral vitamin K in newborns is not established.
Methods: Single-patient chart review.
Case: A seven-day-old male (approximately 3.4 kg) born full-term without complication received 1942 mg oral vitamin K (phytonadione) in a dosing error. Information was obtained via conversation with patient's pediatrician, dispensing pharmacist, and manufacturer. The patient's mother refused IM vitamin K prophylaxis and elected to administer an oral regimen. The patient's pediatrician prescribed 1–2 mg oral vitamin K solution on DOL 7 and 21. The patient received 2 mL of a 971 mg/mL stock solution on DOL 7. The Poison Center was contacted on DOL 9. At that time, the child was reportedly asymptomatic. The concentration was confirmed with the manufacturer. The patient was monitored at home. No coagulation studies were performed as they were unlikely to change management. The patient underwent circumcision with no bleeding 1 week later. A two-month follow-up revealed normal growth and development.
Discussion: We present a case of approximately a thousand-fold dosing error of oral vitamin with no apparent ill clinical effect. There is little information on the effects of massive Vitamin K overdoses in humans. Theoretical risk of inducing prolonged pro-thrombotic milieu exists; however, this child did not show signs of thrombotic events. The dispensing pharmacist was not aware of the stock solution's concentration. Discussion with other health care professionals indicated a lack of awareness of the existence of such a concentrated solution.
Conclusion: Significant dosing errors with concentrated stock solutions of vitamin K can occur, but a toxic dose of vitamin K remains undefined. Given the lack of effects in this case, there is likely a large margin of safety, suggesting that therapeutic errors in vitamin K ingestions can be managed safely at home.

171. Hypoglycemia Associated with Single-Substance Metformin Exposures: a 6-Year Review

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Background: Metformin, a biguanide derivative, is the first-line therapy for pharmacologic treatment of diabetes mellitus (DM) type 2. Metformin toxicity is well known to cause lactic acidosis. Less well described is the incidence of hypoglycemia associated with metformin overdose.
Hypothesis: The study evaluated the incidence of hypoglycemia related to metformin single-substance ingestions as reported to the National Poison Data System (NPDS).
Methods: We queried the NPDS for all human single-substance exposures to biguanides from 2011 to 2016, as metformin is the only commercially available hypoglycemic biguanide in the USA. The number of single-substance biguanide exposure calls was analyzed and categorized by medical outcome to assess the reports of hypoglycemia. Other characteristics assessed included demographics, reason for and route of administration, management site, other medical outcomes, and medical therapies. Descriptive analysis was carried out by calculating and tabulating the frequencies after segmenting them into appropriate categories.
Results: During the study period there were 23,375 single-exposure biguanide calls, and overall the annual number of calls increased. Reason for exposure was overwhelmingly unintentional. The incidence of hypoglycemia was 1.5% ($n = 346$). The most common symptoms were nausea and vomiting. Acidosis was the fourth most common symptom overall with an incidence of 3.6% ($n = 842$). Death was rare at 0.2%, and the majority of outcomes were either no or minor effect. Children under the age of 5 years accounted for 20.4% of all human exposures, but only 11.6% of the exposures that developed hypoglycemia. The most common age group to develop hypoglycemia was age 50–59 years. The most common therapy was food/snack. Supplemental dextrose was only given in 251 cases over the 6 -year span.
Discussion: Young children make up the majority of overall exposures, but a relatively low rate of those developed hypoglycemia. Supplemental dextrose is rarely required for treatment of exposures. The data is subject to usual poison center registry limitations. Hypoglycemia could be

explained by increased glucose consumption during anaerobic cellular metabolism. Ketosis from excessive vomiting could also result in hypoglycemia.
Conclusion: Although the incidence is low, this review shows that hypoglycemia can occur in single-substance biguanide exposures.

172. A Case Report of Profound Linezolid-Induced Lactic Acidosis

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Background: Lactic acidosis is arbitrarily divided into Type A, where there are signs of tissue hypoperfusion, and Type B, where there are signs of metabolic dysfunction at the cellular level. Linezolid is an oxazolidinone antibiotic that blocks bacterial protein synthesis by inhibiting bacterial ribosomes. The goal of this report was to present a case of severe lactic acidosis that completely resolved with cessation of linezolid suggesting linezolid may have a role in contributing to a Type B pathophysiology.
Methods: Single-patient chart review.
Case: A 71-year-old female presented to our emergency department complaining of nausea and a syncopal episode. The patient was found to have an anion gap of 22 meq/L and a lactic acidosis of 10.9 mmol/L. She was also newly thrombocytopenic with a platelet count of 22,000 $10^3/\mu l$. She was afebrile with no evidence of hypoperfusion. The patient had previously been started on linezolid 16 days previously for oxacillin-resistant staph epidermidis bacteremia. After a thorough evaluation, she was admitted to the hospital for possible linezolid-induced lactic acidosis and thrombocytopenia. She was subsequently transitioned to enteral vancomycin. During her 12 days of hospitalization, the patient received supportive care but no specific interventions. Her lactic acidosis normalized to 1.7 mmol/L before discharge. A hematology consult identified no other cause for her thrombocytopenia apart from a suspected adverse reaction to linezolid and her platelet count improved to 244,000. The patient's nausea resolved and she was discharged at her baseline of health.
Discussion: Physicians often encounter patients with lactic acidosis. After thorough assessment for tissue hypoperfusion, it is also prudent to consider drug-related lactic acidosis. Common culprits include biguanides (metformin), aspirin, antiretrovirals, toxic alcohols, cyanide, and carbon monoxide. Linezolid should also be included on this list. A growing body of literature suggests that linezolid may also interfere with human mitochondrial ribosomes, due to structural similarities with bacterial ribosomes, resulting in defective cellular metabolism and Type B lactic acidosis.
Conclusion: Physicians should consider linezolid-induced lactic acidosis when evaluating patients with lactic acidosis of unclear etiology.

173. Treatment for Acute and Chronic Methotrexate Poisoning Treatment for Acute and Chronic Methotrexate Poisoning.

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Objectives: We aimed to review acute and chronic methotrexate (MTX) overdoses as well as therapeutic studies that provide pharmacokinetic or clinical data on MTX toxicity.
Methods: A retrospective audit was performed of acute and chronic MTX poisoning through the New South Wales Poisons Information Centre from April 2004 to July 2015 to determine the clinical syndrome and toxicity of MTX. A literature search was performed on MTX poisonings and high-dose MTX use, bioavailability, drug interaction and treatment.
Results: In the NSW PIC audit data (2004–2015), there were 15 paediatric and 26 adult acute poisonings. Median age and dose were 47 years (IQR: 31–62) and 325 mg (IQR: 85–500; range: 40–1000) respectively. Median reported paediatric age and ingestion were 2 (IQR:2–2) and 50 mg (IQR:10–100, range:40–1000). Of the patients who had serum MTX concentration measured, none were above the nomogram. No patients reported adverse sequelae. There were 21 chronic MTX poisonings. Median age was 62 years (IQR: 52–77), with stomatitis/mucositis (30%) and neutropenia (30%) being the most common symptoms. There were 66 papers included in the review. Pharmacokinetic data showed that MTX bioavailability is greatly reduced as oral doses increase with a possible ceiling dose in acute ingestion. Oncology data suggested that patients treated with an intravenous dose of $<1\ g/m^2$ MTX do not generally require or need folinic acid rescue. There is no feasible acute oral overdose that is likely to provide $>1\ g/m^2$ of systemically absorbed MTX or lead to serum MTX concentrations above the oncology folinic acid treatment line. In contrast, daily administration of low dose MTX for as little as 3 days has caused significant morbidity. Acute overdose in the setting of renal impairment mimics this exposure. Serum MTX concentration did not correlate well with toxicity or mortality in these patients.
Conclusion: In acute deliberate MTX poisoning, there are no situations in which it would be expected that toxicity will occur unless patient has renal impairment. In chronic poisoning, folinic acid and supportive care are recommended until patients recover. There is no rationale to monitor MTX concentration in either acute or chronic poisoning.

174. Bismuth Subsalicylate Coagulopathy in a Patient with Chronic Liver Disease

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Background: Although rarely reported in the literature, coagulopathy in the setting of acetylsalicylic acid toxicity has occurred, especially in liver disease patients, but there are no reported cases associated with bismuth subsalicylate (BSS). BSS is the active ingredient in over-the-counter antacid and antidiarrheal medications.
Hypothesis: BSS can cause coagulopathy in a patient with liver disease.
Methods: Single-patient chart review.
Case: A 62-year-old woman with a history of HCV cirrhosis presented to the ED with 1 week of nonbloody diarrhea and confusion. The patient had disorientation and slowed affect. There were no tremors, clonus, or asterixis. She admitted taking 8.3 g daily of BSS over the 5 days prior. The patient was tested for sequelae from salicylate and bismuth toxicity. The patient's initial labs were significant for pH 7.37, pCO_2 18 mmHg, HCO_3 10 mmol/L, salicylate 50 mg/dL, PT 61.2 s, PTT 46.2 s, and INR 7.7. Her factor V was low at 54%. Coagulation studies from 2 weeks prior were PT 14.1 s, PTT 31.3 s and INR 1.4. She had normal hepatic transaminases and synthetic liver function. Over the subsequent 24 h, intravenous sodium bicarbonate and dialysis reduced salicylate to < 10 mg/dL. After receiving fresh frozen plasma and vitamin K, the patient's INR normalized. Her bismuth concentration was 147.6 mcg/L (normal 0.3–4.6 mcg/L) and 4 mcg/L (normal 0–9 mcg/L) in the urine and blood, respectively. The patient's neurological symptoms resolved within 48 h.
Discussion: Salicylic acid toxicity results in inhibition of vitamin K-dependent coagulation factors (VKDCF) and decreased prothrombin, which can be prevented with vitamin K. Salicylic acid is absorbed from BSS in the stomach. The patient's high PT suggests inhibition of VKDCF. Factor V can be decreased in hypoprothrombinemia in liver disease patients. This is the first published case report of coagulopathy secondary to BSS in a liver disease patient.
Conclusions: Given the widespread use of BSS products, it is important for coagulopathy to be considered as a possible manifestation of toxicity. As demonstrated in this case, patients with underlying liver disease may be predisposed to coagulopathy after overdose.
Abstract Index

ACMT 2018 Annual Scientific Meeting Abstracts – Washington, DC.