CLINICAL TOXICOLOGY
2022, VOL. 60, NO. S2, 1–162
https://doi.org/10.1080/15563650.2022.2107776

Taylor & Francis
Taylor & Francis Group

North American Congress of Clinical Toxicology (NACCT) 2022

1. Accuracy of a glycerol dehydrogenase assay for ethylene glycol screening

Ari Filip[a], Christopher Farnsworth[b] and Michael Mullins[a]

[a]Department of Emergency Medicine, Washington University in St. Louis, St. Louis, MO, USA; [b]Department of Pathology and Immunology, Washington University in St. Louis, St. Louis, MO, USA

Background: Headspace gas chromatography (HS-GC) is the gold-standard method for quantifying ethylene glycol (EG), a common toxic component of consumer products. However, HS-GC is unavailable at most acute care hospitals, with formal diagnosis often occurring in delayed fashion. Left untreated, EG causes metabolic acidosis, renal failure, and death. However, empiric treatment of presumed toxicity requires antidote choices which may be expensive, difficult to administer, or invasive. Several studies have demonstrated the utility of a glycerol dehydrogenase (GDH) based assay (Catachem, Inc.) on automated chemistry analyzers for EG testing, but it has not been widely adopted and data regarding the relative accuracy of the GDH method are scarce. However, the rapid turnaround time of the GDH assay and wide availability of compatible automated instrumentation imply that it could be useful for providing rapid diagnostic clarity in screening for EG. In patients with suspected ethylene glycol toxicity, does a GDH assay have comparable performance for EG screening relative to HS-GC?
Methods: This is a prospective, observational analysis of banked, remnant serum samples submitted to the core clinical chemistry laboratory of a large, multi-hospital healthcare system. Investigators examined all samples, which were submitted for the explicit purpose of testing for suspected ethylene glycol ingestion. Investigators collected samples over a 12-month period, which were frozen at −20 °C. All samples had standard of care testing using a laboratory developed, HS-GC method and were then analyzed with the GDH-based assay. The limit of detection for the GC-method was 4 mg/dL and for the GDH was 6 mg/dL. Samples in which the GDH assay had not yet been performed were excluded from the final analysis. Data analysis was performed using Graphpad Prism v9.
Results: A total of 115 samples were referred for testing. We excluded 6 samples from the final analysis as they did not undergo testing with the GDH assay. Of the 109 remaining samples, 86 had no ethylene glycol detected by HS-GC and 23 were "positive." These 23 samples represent 6 patients. Judged at the manufacturer's screening cutoff of 6 mg/dL EG, there was 100% (95% CI; 85.7–100) positive percent agreement (PPA) and 98% (95.7–100) negative percent agreement (NPA). When adjusted to a threshold of 9 mg/dL, still well below the accepted treatment threshold of 20 mg/dL, we observed a 100% PPA and NPA and a receiver operator characteristic area under curve =1.0. Deming regression of the observed concentrations revealed a slope of 1.05 (0.73–1.36) and an intercept of −12.4 (−41.7–17.0).
Conclusions: The GDH assay provides sensitive and specific screening for EG that is comparable to an HS-GC-based method. More widespread use of this rapid, inexpensive assay could impact EG antidote stewardship, patient length of stay, and resource utilization. Further study is needed to quantify the effect of this screening on real-time patient treatment decisions.

KEYWORDS Ethylene; glycol; testing

ari.filip@gmail.com

2. Targeted evaluation of genetic variants involved in acetaminophen metabolism and drug induced liver injury are not predictive of ALT elevation in therapeutic dosing

Andrew Monte[a], Ian Arriaga Mackenzie[b], Jack Pattee[b], Sasha Kaiser[a], Meher Boorgula[c], Monica Campbell[c], Barry Rumack[d], Katherine Reynolds[a], Richard Dart[e] and Kennon Heard[f]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]Department of Biostatistics and Informatics, University of Colorado, Denver, CO, USA; [c]Department of Medicine, University of Colorado, Denver, CO, USA; [d]School of Medicine, University of Colorado, Denver, CO, USA; [e]Denver Health and Hospital Authority, Denver, CO, USA; [f]University of Colorado, Aurora, CO, USA

Background: Acetaminophen (APAP) is the leading cause of acute liver failure in the US. While the vast majority of hepatotoxicity is in the setting of overdose, some patients will develop liver injury (DILI) even at therapeutic doses. It is unclear if hepatic injury at therapeutic dosing occurs via the same toxic metabolic pathway with the formation of N-acetyl-p-benzoquinone imine (NAPQI), or the result of genetic variations in other APAP metabolic or other DILI pathways. Our objective was to determine if the hepatic adaption that occurs in APAP therapeutic dosing is a result of gene variations within known acetaminophen metabolism pathways.
Methods: We performed genetic analyses on patients that ingested 4 g of acetaminophen for up to 16 days as part of a previously completed randomized controlled clinical trial (NCT00743093). Subjects were administered acetaminophen 4 g/day. Alanine aminotransferase (ALT) was drawn on study days 0 (baseline), 4, 7, 10, 13 and 16. Microarray genotyping was performed on the custom Multi-Ethnic Global Array 2 (MEGA-2, Illumina, Inc.). Autosomes were aligned and imputed using the TOPMed imputation server, which included all information to Genome Reference Consortium human genome version 38 (GRCh38). Copy number variants (CNVs) in CYP2E1 were captured using the PENN CNV software. We utilized adaptive sum of powered score (aSPU) to perform association testing and examined functional variants in each gene taken

together as a genetic unit. The gene was the unit of analysis rather than individual variants to account for additive effects of numerous variants within the same gene. Linkage disequilibrium pruning was set at 0.1. Categorical age, gender, and race were included in the model. The primary outcome was maximum ALT over the study period. Bonferroni multiple correction was utilized.
Results: We enrolled 205 subjects. After genotyping, 199 samples passed quality control and were included in the analysis. There were 12 (6%) African Americans, 3 (2%) East/Southeast Asians, 2 (1%) Western Asians, 138 (69%) Caucasians, 1 (0.5%) Native Hawaiian/Pacific Islander, 11 (6%) mixed race, and 32 (16%) Hispanics. The mean ALT was 38 IU/L (SD: ±26) and the max ALT during the study period was 88 IU/L (SD: ±33). The only gene associated with max elevated ALT was SULT1E1. Sulfate conjugation catalyzed by sulfotransferases (SULT) are involved in the biotransformation of multiple xenobiotics. SULT1E1 is one of the sulfotransferases responsible for the acetaminophen sulfation, the 2nd most common pathway of conjugation for drug clearance. Other genes involved with acetaminophen metabolism or previously described as associated with drug induced liver injury were not associated with ALT elevation.
Conclusions: The majority of genes associated with acetaminophen metabolism at therapeutic doses are not associated with maximum ALT elevation when the drug is administered daily for 16 days. Variants in SULT1E1 were associated with maximum ALT elevation, though the implications of this finding are unclear. Future studies examining ALT elevation during therapeutic dosing of acetaminophen should focus on hepatic adaption pathways.

KEYWORDS Acetaminophen; genetic analysis; hepatic adaption

andrew.monte@cuanschutz.edu

3. US shortages of agents used to treat poisonings over the last 10 years (2012–2021)

James Whitledge[a], Erin Fox[b] and Maryann Amirshahi[c]

[a]Harvard Medical Toxicology Fellowship, Boston Children's Hospital, Boston, MA, USA; [b]University of Utah Health, Salt Lake City, UT, USA; [c]MedStar Washington Hospital Center, Bethesda, MD, USA

Background: Drug shortages represent a longstanding challenge for healthcare providers, including toxicologists, who continue to confront scarcities of antidotes and other agents used to treat poisonings. Prior research examining availability of drugs with toxicologic applications from 2001 to 2013 demonstrated broad shortages including anticholinergic, cholinergic, and cyanide antidotes, anti-hypoglycemics, chelators, antivenom, naloxone, sedative-hypnotics, and decontamination products, many of which were unresolved and involved xenobiotics without therapeutic alternative. Reports of vital agents being scarce or unobtainable have continued since 2013, and new pressures on global and US (United States) supply chains have emerged, most notably the COVID-19 pandemic. Given this, up-to-date analysis of shortages of agents used to treat poisonings is needed.
Methods: US drug shortage data from January 2012 to December 2021 were obtained from the University of Utah Drug Information Service. Shortage data for agents used to treat poisonings were analyzed. Information on drug type, formulation, shortage reason, shortage duration, number of manufacturing sources, substitute availability, and substitute agent shortage during the study period were investigated.
Results: 1570 drug shortages were reported during the study period; 230 (14.6%) involved agents used to treat poisonings. Of the 230 shortages, 21.3% were unresolved as of December 2021. Mean shortage duration was 13.6 months. The longest shortage involved intravenous calcium gluconate and lasted 78 months. Intravenous dextrose products were the agent most frequently affected by shortage, with 20 shortages in total. 58 agents had multiple shortages. Total shortages peaked in 2017 with 33 shortages reported. 20 shortages were reported in 2020 and 24 in 2021 during the COVID-19 pandemic. 10.9% of shortages involved single-source products; however, this number is limited by incomplete reporting. 80.9% of shortages involved parenteral products. Agent classes with the most shortages reported were: sedative-hypnotics (12.2% of shortages), anti-hypoglycemics (9.6%), anticoagulant reversal (7.8%), vitamins/electrolytes (7.4%), blood pressure support (7%), antihypertensives (6.5%), antimuscarinic delirium (4.8%), and chelators (4.3%). Three naloxone shortages were reported, one of which is ongoing due to increased demand. Buprenorphine and methadone shortages were reported but are resolved as of December 2021. New shortages of multiple pressors and flumazenil were reported. The most common reason for shortage was a manufacturing issue, occurring in 36.1% of shortages. Shortage reason was not reported 37.8% of the time. For 77% of shortages an alternative therapeutic agent was available, however 97% of alternatives were also affected by shortage at some point during the study period.
Conclusions: Shortages of agents used to treat poisonings remain problematic. For the time period 2011–2021 previously reported shortages of many products persist and new shortages have emerged. The ongoing naloxone shortage is particularly concerning given the continued rise in drug overdose deaths in the US in 2021, as are shortages of buprenorphine and methadone used to treat opioid use disorder. Despite supply chain stressors, total shortages did not peak during the COVID-19 pandemic.

KEYWORDS Drug shortage; antidote; substitute drug

james.whitledge@childrens.harvard.edu

4. Are hospitals ready for the sodium nitrite surge? Availability of methemoglobin testing and methylene blue stocking in a 3-state region

Travis Olives[a], Jack Goldstein[b], Morgan Forgette[c], Paul Young[d] and Jon Cole[a]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]University of Minnesota Medical School, Minneapolis, MN, USA; [c]Des Moines University, Des Moines, IA, USA; [d]Hennepin Healthcare, Minneapolis, MN, USA

Objectives: Historically, acquired methemoglobinemia rarely presented in fulminant and life-threatening forms, however, intentional sodium nitrite poisonings leading to life-threatening methemoglobinemia (metHgb) and sudden cardiovascular collapse appear to be increasing in frequency. Promptly diagnosed and treated with methylene blue (MB) within minutes of presentation, these cases represent a source of preventable poisoning mortality. We describe hospital-based diagnostic testing capacity for metHgb and availability of methylene blue across a three state region in the upper midwest, with specific attention to differences in rural and urban areas.
Methods: Cross-sectional telephone survey of all hospitals in a 3-state area served by a single regional Poison Center (PC). State trauma databases, health department websites, and PC databases were used to identify hospitals. Each site was queried for metHgb testing capacity and immediate availability of MB. Hospitals without emergency departments (EDs) were excluded.

Descriptive statistics and spatial mapping of testing and treatment availability are reported. This study was deemed not human research by our IRB.
Results: A total of 320 sites were identified. Of these, 92 (28.8%) were excluded (duplicate record: 47; no ED: 33; closed: 6; unable to contact before analysis: 4; not a hospital: 2). Of 228 included hospitals, 182 (79.8%) were able to order testing for methemoglobinemia, of which 127 (69.8%) were only available as send-out tests. Only 56 (30.8%) of hospitals reported results available in real time, including two concurrently reported as sendouts. Availability of real-time metHgb testing was inversely associated with population density (Fisher's exact test =0.000). Regression analysis revealed a persistent association between population density and real-time testing (t-value = −3.78, p = 0.000) and any testing (t-value = −2.55, p = 0.012) when controlling for American College of Surgeons (ACS) trauma designation, included as a marker of resource availability. Of 221 hospitals providing responses regarding availability of MB, 60% (129/221) reported onsite availability of MB, ranging from 11/11 (100%) in urban areas of >50,000 inhabitants to 32.1% in rural areas (26/81) of <2500 inhabitants (Fisher's exact test =0.000). Available vials of MB ranged from 0 to 81 among 135 responding hospitals and were inversely associated with population density (Fisher's exact test =0.000). The association between MB availability and population density persisted in regression analysis controlling for ACS trauma designation (t-value = −3.49, p = 0.001). Spatial distribution of metHgb testing availability and reported MB availability among reporting hospitals both concentrate within urban regions.
Conclusions: As reports of acute intentional ingestions of strong oxidizers such as sodium nitrite rise, we describe an urban:rural divide in MetHgb diagnostic and therapeutic capacity in our 3-state region. While PCs provide critical consultative input to providers in their service areas, it is important to understand diagnostic and therapeutic resources available to the healthcare providers who seek our services. Our data highlight a substantial gap in antidote stocking that may lead to preventable poisoning deaths.

KEYWORDS Methemoglobinemia; methylene blue; rural

travis.olives@hcmed.org

5. Amlodipine anxiety: a 10-year review of amlodipine associated fatalities

Brian Bush and Sean Bryant

Toxikon Consortium, Chicago, IL, USA

Background: Amlodipine is a commonly prescribed dihydropyridine calcium channel blocker (CCB) used in the treatment of hypertension. An overdose may be associated with hypotension, cardiovascular collapse, and/or death. Anecdotally our regional poison center (RPC) has noted an increased number of amlodipine cases and fatalities over the last several years. The purpose of this study was to describe, quantify, and trend the number of amlodipine-related fatalities from our RPC over the past decade.
Methods: This is a retrospective, single RPC review of the NPDS database (www.npds.us). The NPDS was queried for all amlodipine-related fatalities submitted from our RPC over the last 10 years (2012–2021). Fatalities in which amlodipine was listed as the single drug ingested or part of a mixed (i.e., multiple drug) ingestion were included. Only those cases where amlodipine was determined to be undoubtedly responsible, probably responsible, or contributory were included. Demographic data for each case was recorded. Cases were manually reviewed for selected therapeutics used in management; specifically the use of high-dose insulin infusion (HDI), intralipid emulsion (ILE), methylene blue (MB), vasopressors (VP), and ECMO. Total amlodipine cases managed by our RPC for each year were compared to amlodipine-related deaths and proportional trends were compared to non-amlodipine CCB-related fatalities. Descriptive statistics are reported.
Results: A total of 37 amlodipine-related fatalities occurred over the past decade. The average age was 51 years, with a slight female predominance. The majority of cases were mixed ingestions (70.3%, 26/37) while a minority were exclusively single product amlodipine ingestions (29.7%, 11/37). Use of vasopressors was most common in these cases (97.3%, 36/37), followed by HDI (81.1%, 30/37), then use of ILE (35.1%, 13/37). MB was used in only 18.9% of cases (7/37) while none of the cases received ECMO. The annual proportion of fatalities caused by amlodipine dramatically shifted in 2018 and continues to trend up to 10.64% by 2021. In fact, in 2018 amlodipine-related fatalities became the primary CCB associated with fatalities and remain so through 2021.
Conclusions: Fatalities from intentional ingestion of amlodipine have risen over the past decade as reported to our RPC, with a significant increase most noted over the last 4 years (2018–2021). Since 2018, amlodipine is implicated in more deaths from our RPC than all other CCBs together. One possible reason for this trend could be the ease of access and wide prescribing pattern of this drug. For our RPC, CCB poisoning and related fatality has evolved and become more specifically "amlodipine poisoning and related fatality." Future study is needed to determine national trends and the associated risk factors concurrent with increased risk of death from amlodipine poisoning.

KEYWORDS Amlodipine; fatalities; data trends

bbushy75@gmail.com

6. Vasodilation in patients with calcium channel blocker poisoning treated with high dose insulin: a comparison of amlodipine versus non-dihydropyridines

Jon Cole[a], Samantha Lee[a], Matthew Prekker[b], Nathan Kunzler[a], Kelly Considine[b], Brian Driver[b] and Travis Olives[a]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]Hennepin Healthcare, Minneapolis, MN, USA

Background: High dose insulin (HDI) is a standard therapy for calcium channel blocker (CCB) poisoning. HDI is an inodilator, increasing inotropy via multiple mechanisms while also causing vasodilation via stimulation of endothelial nitric oxide synthase (eNOS). Most literature supporting HDI for CCB poisoning involves verapamil toxicity; however, amlodipine is now the most common CCB implicated in poisoning. Amlodipine, unlike other CCBs, stimulates eNOS and has the potential for synergistic vasodilation between HDI and amlodipine. The purpose of this study was to determine if amlodipine-poisoned patients treated with HDI had more evidence of vasodilation than similarly treated patients with non-dihydropyridine (non-DHP) poisoning. Outcomes included the maximum number of vasopressor infusions per case, use of rescue methylene blue as a nitric oxide scavenger to treat refractory vasoplegia, and vasopressor doses.
Methods: This was a retrospective study from a single poison center (PC) with a CSPI-driven guideline to initiate HDI in CCB poisoning. Cases were identified by querying our electronic database (Toxicall®) for the generic substance code "Calcium Antagonists" (262000) in which the therapy "High Dose Insulin/

Glucose" was "performed, whether or not recommended" from 2019 to 2021. Since 2019, a quality metric in our PC has been to routinely record vasopressor infusion rates on callbacks. Cases were abstracted by a single medical toxicologist.

Results: Thirty-three CCB poisoning patients were treated with HDI during the study period: 18 poisoned with amlodipine, 15 with non-DHPs (verapamil $n = 10$, diltiazem $n = 5$). Baseline characteristics, including vital signs and co-ingestions, outcomes and concomitant therapies other than vasopressors were similar between groups. Median maximum HDI infusion rate was 10 units/kg/h in the amlodipine group (IQR: 3.4–11; range 1–20) and 5 units/kg/h in the non-DHP group (IQR: 1–10; range 1–20). The median number of maximum concomitant vasopressors in the amlodipine group was 3 (IQR: 2–5; range 0–6) and 2 in the non-DHP group (IQR: 1–3; range 0–5; Mann–Whitney-U $p = 0.04$); median difference in maximum concomitant vasopressors between groups was 1 (95% confidence interval: 0–2). Use of rescue methylene blue was more common in the amlodipine group (7/18 [39%]) than in the non-DHP group (0; $p = 0.09$, Fisher's exact). Median maximum epinephrine dosing was higher in the amlodipine group (0.31 mcg/kg/min) compared to non-DHPs (0.09 mcg/kg/min; $p = 0.03$ Mann–Whitney-U). Use of epinephrine ($n = 11$), vasopressin ($n = 11$), phenylephrine ($n = 7$), and angiotensin II ($n = 4$) were more common in the amlodipine group than in non-DHPs ($n = 6, 6, 2, 0$ respectively).

Conclusions: Amlodipine poisoned patients treated with HDI displayed evidence of more vasodilation than patients poisoned with verapamil or diltiazem. Given the retrospective nature of the study, it is unclear if this additional vasodilation represents more severe distributive shock from amlodipine poisoning, or iatrogenic vasodilation from HDI. As HDI has a dose-dependent relationship with both inotropy and vasodilation, care should be taken to establish the optimal HDI dose to maximize inotropic support while minimizing iatrogenic vasodilation, particularly in amlodipine-poisoned patients given the possibility for synergistic vasodilation.

KEYWORDS High dose insulin; calcium channel blockers; critical care

jonbcole@gmail.com

7. Retrospective evaluation of management guidelines for extracorporeal treatment of metformin poisoning

Josh Trebach[a,b], Sanjay Mohan[a,b], Marlis Gnirke[b], Mark Su[b], Sophie Gosselin[c] and Robert S. Hoffman[a]

[a]NYU Langone Health Department of Emergency Medicine, New York, NY, USA; [b]New York City Poison Control Center, New York, NY, USA; [c]Centre Antipoison, Knowlton, QC, Canada

Objectives: The Extracorporeal Treatments in Poisoning (EXTRIP) Workgroup defined criteria for extracorporeal toxin removal (ECTR) in patients with metformin poisoning. The primary outcome of this study was to determine the benefit of ECTR in patients meeting the EXTRIP recommended (1D) criteria. The secondary outcome was to determine the performance characteristics (sensitivity, specificity, positive predictive value, negative predictive value) of those EXTRIP 1D criteria.

Methods: This was a single-center retrospective analysis of metformin poisoned patients. We performed a structured query language (SQL) search for all cases of suspected human metformin poisoning entered in the poison center database between January 1, 2000 and April 30, 2021. Cases were manually reviewed by two authors who were blinded to the study hypothesis and data were extracted and entered into a predesigned REDCap form. Cases met inclusion criteria if they met at least one of the definitional criteria for metformin associated lactic acidosis (MALA): lactate concentration >5 mmol/L; pH <7.35; or impaired kidney function. Cases were excluded if they were poorly or incorrectly coded, incomplete, or were home calls. Cases were analyzed based on EXTRIP criteria, if ECTR was performed, and survival. Data were analyzed with a Chi-squared test or Fisher's Exact test as appropriate, with a $p < 0.05$ considered statistically significant. Sensitivity, specificity, NPV, and PPV were calculated with respect to the EXTRIP criteria and death.

Results: Of 201 patients who met inclusion criteria, 145 patients met at least one of the EXTRIP 1D criteria (EXTRIP+) and 56 patients did not (EXTRIP−). Among the patients who met EXTRIP criteria, 96 received ECTR (ECTR+) and 49 did not (ECTR-). In the group that received ECTR, 75.0% ($n = 72$) survived and 25.0% ($n = 24$) died versus 73.5%($n = 36$) and 26.5% ($n = 13$) in the group that did not receive ECTR ($p > 0.05$). Among the 56 patients who did not meet any EXTRIP criteria,100% survived (NPV =100%). With respect to death the EXTRIP criteria had the following other performance characteristics: Sensitivity, 100%; Specificity, 34.1%; and PPV, 25.5%. The patients who were both EXTRIP + and ECTR + were further examined in a post hoc subgroup analysis as to whether a major adverse event occurred, defined either as intubation/pressor requirement/cardiac arrest/CPR prior to initiation of ECTR, or whether there was an interruption in ECTR. Among the patients who met EXTRIP criteria and received ECTR, 72 survived and 24 died. Of the 72 who survived, 55.6% ($n = 40$) had adverse event(s) prior to completion of ECTR, compared to 95.8% ($n = 23$) in the group that died ($p < 0.05$). In fact, 32/33 (97.0%) patients who met EXTRIP criteria and underwent hemodialysis before a major adverse event occurred survived.

Conclusions: In this retrospective analysis, the EXTRIP recommended (1D) criteria had an NPV for the death of 100%. Further study is needed to evaluate the benefit of ECTR in patients meeting EXTRIP criteria for metformin poisoning

KEYWORDS Metformin; EXTRIP; dialysis

jtrebach@gmail.com

8. Early collapse is indicative of severe envenomation in Australian Snakebite (ASP-31)

Geoffrey Isbister[a], Shane Jenkins[b] and Katherine Isoardi[c]

[a]Calvary Mater Newcastle, Carrington, Australia; [b]University of Newcastle, Newcastle, Australia; [c]Princess Alexandra Hospital, Brisbane, Australia

Objectives: Early collapse is an uncommon but important manifestation of snake envenoming in Australia. We aimed to describe the frequency, clinical effects and complications of patients with early collapse in Australian snake envenomation.

Methods: We reviewed all cases of snake envenomation from the Australian Snakebite Project (ASP: July 2005–June 2020) and extracted demographic information, snake type based on expert identification or venom specific enzyme immunoassay, clinical effects, complications and outcomes. We compared envenomated patients with and without early collapse using Fisher's exact test for dichotomous outcomes.

Results: There were 1263 snakebite patients with envenomation and 160 (13%) of these had an early collapse. Of the 160 with collapse, 128 (80%) were male and the median age was 42 years (interquartile range [IQR]: 25–56 years), similar to envenomated patients without collapse. The median time to collapse post-bite was 20 min (IQR: 10–35 min; range 2–60 min). 90 of the 160

(56%) patients with collapse were envenomated by brown snakes (*Pseudonaja spp.*) and 22 (14%) by tiger snakse (*Notechis spp.*) or rough-scaled snakes (*Tropidechis carinatus*), but none by death adders (*Acanthophis spp.*) or mulga snakes (*Pseudechis spp.*). This differed to patients without collapse, with a more even spread of snake types. 157 patients (98%) with collapse developed venom induced consumption coagulopathy (VICC), and only 4 (3%) neurotoxicity and 7 (4%) myotoxicity. There were 35 patients (22%) who had a cardiac arrest following collapse compared to six patients (0.5%) without collapse, which was significantly different (difference 21%; 95% confidence interval [CI]: 14–27%; $p < 0.0001$). 21 patients (13%) with collapse died compared to 11 (1%) without collapse (difference: 12%: 95% CI:6–17%; $p < 0.0001$). The length of stay and number of patients receiving antivenom was similar between groups.
Conclusions: Almost all envenomated patients with early collapse developed VICC, the majority after brown snake bites. They were more likely to have a cardiac arrest and die, compared to those without collapse. Collapse occurred within 1 h, most within 30 min of the bite.

KEYWORDS Snakebite; envenomation; cardiac arrest

geoff.isbister@gmail.com

9. Time-series forecasting utilizing gated recurrent units for the predication of daily call volumes to a US poison center

Nikolaus Matsler and Christopher Hoyte
Rocky Mountain Poison and Drug Safety, Denver, CO, USA

Background: Call volumes to Poison Centers (PC) can vary greatly by day. This can present resource challenges in terms of staffing, as fluctuating call volumes can result in either long wait times for callers or misallocated resources if over-staffed. We sought to predict daily call volume utilizing machine learning (ML).
Methods: A time-series forecasting model was constructed utilizing Gated Recurrent Units (GRU) within a deep learning neural network (NN). A separate model utilizing Long-Short Term Memory (LSTM) units was also constructed for comparison. Daily call volumes for a large US PC were collected for the previous 5 years. Features were engineered to express the cyclic nature of calls within year, month, and day of week, along with season and presence of US holiday. Features and labels were split into training and validation sets at 80/20, 90/10, and 95/5 ratios. Number of neurons, hidden layers, scalar functions, learning rate, weight decay, dropout, and number of epochs were varied to determine optimal network parameters. Forecasting was performed for the next 365, 182, and 91 days, and comparison of prediction versus actual daily call volume performed. Throughout iterations of the model, root mean square error (RMSE), loss, R squared, and min/max/mean of predictions versus actual calls were collected.
Results: Our dataset consisted of 5 years (1826 days) worth of daily call volumes to a US PC, with an average volume of 375.6 calls/day (min 174, max 813). Month-of-year and day-of-week were both transformed using sine/cosine functions into cyclical features. Time lag features were then created by shifting days by 100 and were included in the feature vector. Holidays were added via one-hot-vector encoding. After comparison, the GRU model consistently outperformed the LSTM model, as described by an average difference of predicted calls versus actual of 29.82 calls/day compared to 56.1 calls/day, respectively, across the three forecasting time periods (365, 182, 91 days in the future). For our GRU model, this represents an average error of 7.9% of daily calls when compared to average volume. There were outliers in both groups, with the largest discrepancy in predicted versus actual of 180 calls in the GRU model and 355 calls in the LSTM The RMSE for our GRU was an average of 39.7 across the three forecasting groups, while the LSTM averaged 69.2.
Conclusions: Accurately predicting call volumes can allow PCs to allocate resources more efficiently, leading to shorter wait times for callers, as well as less potential overstaffing. Our model demonstrates that GRU time-series forecasting can accurately predict daily call volumes within 8% of average daily volume. This model can easily be converted for utilization within any regional PC given adequate historical data. Further, this model can be extended beyond daily forecasting and be utilized for hourly forecasting as well. In addition, continued feature engineering may yield improvements in the forecasting model.

KEYWORDS Machine learning; time-series forecasting; poison center call volume

nik.matsler@denverem.org

10. Using contact center industry standardized metrics to evaluate a poison control center's service level and objectively determine the necessary amount of specialists in poison information needed to match case volume

Ashley Webb
Kentucky Poison Control Center of Norton Children's Hospital, Louisville, KY, USA

Background: US Poison Control Center (PCC) case volume has been in decline but this is driven largely by a loss of drug identification requests and minimally toxic exploratory exposures managed on-site. Complex cases requiring multiple consultations with healthcare facilities have not seen the same drastic decline and the amount of work related to follow-up contact and case management has been increasing. Like most PCCs, an objective evaluation of specialist FTEs (full time equivalents) based on benchmarked contact center metrics had not been performed. Outside of abandonment rate and a large variable human exposure case/FTE rate (2000–5500), these metrics have not been defined for PCCs. As contact centers have evolved in complexity with the ability to capture more detailed metric information, abandonment rate is no longer an acceptable metric to determine if staffing levels meet demand. Because PCCs operate in a demand-chasing model it is necessary to use defined metrics and complex calculations, such as the Erlang C, to staff in anticipation of contacts based on historic averages and to do so in a way that maximizes customer service, maintains a reasonable workload, and provides for shrinkage and schedule inflexibility.
Methods: In this quality assurance and staffing evaluation project, we sought to define standardized contact center metrics that could be easily applied to PCC operations to objectively determine the optimum FTEs required to enhance customer service and reduce PCC specialist burn-out based on our call volume and mix. Using previously published data on average handling time (AHT) of PCC cases with varying complexity, we established an acceptable AHT and calculated caller patience to evaluate our current service level, occupancy, and shrinkage. We then used these metrics to define an acceptable service level, and using an Erlang C model with consideration for an acceptable workload throughout a 24 period and accounting for anticipated shrinkage, we determined the amount of FTEs necessary

to staff our PCC in a manner that improves service level and balances staffing cost while reducing staff burn-out.
Results: At the time of this project we operated with 14.3 PCC specialist FTEs and we were able to show objectively that our PCC was not staffed to meet customer demand. With our total daily inbound and outbound volume of 267 contacts, our average service level across a 24 h period was below 80%, insufficient for any call center type. Our PCC was understaffed 96% of the time and occupancy often approached or exceeded 80%, a level at which contact center staff experience burn-out. Furthermore, the shrinkage rate in our PCC was 15.4%, below the typical contact center standard of 30%. We further determined that based on our contact volume, our PCC would ideally require between 16.5 and 18 FTEs, with a max of 19.9 FTEs to account for schedule inflexibility.
Conclusions: Although we have not evaluated these metrics outside of our PCC, standardized contact center metrics defined for PCC operations could lead to quality improvement projects and provide justification for improved PCC funding based on objectively determined necessary staffing volumes.

KEYWORDS Poison Control Centers; staffing; case volume

ashley.webb@nortonhealthcare.org

11. How NPDS upload edits improve coding quality: a case study

Edward Bottei[a] and Alvin Bronstein[b]

[a]Iowa Poison Center, Sioux City, IA, USA; [b]Hawaii Department of Health, Honolulu, HI, USA

Background: The American Association of Poison Control Center's (AAPCC) National Poison Data System (NPDS) collects de-identified case data from all 55 US poison control centers (PCC). The coding of call type, substances involved, clinical effects, medical outcome, and other data fields is performed by specialists in poison information and poison information providers at each center. Every PCC has a quality assurance program responsible for reviewing management, treatment, and overall coding quality. To trap incompatible or contradictory coding, NPDS has multiple AAPCC Board approved edits (rules) designed to reject cases with obvious coding errors. One such edit was initiated on March 18, 2014. This edit rejects exposure cases in children <6 years of age with reason coded to Intentional-Suspected Suicide (ISS). This rule causes a "non-fatal" case rejection and can be overridden by the managing center.
Methods: NPDS data were searched from June 01, 2000 through March 17, 2014 (Period 1) and from March 18, 2014 through March 09, 2022 (Period 2). Inclusion criteria were exposure cases with reason of ISS and a patient age of ≤5 years old. Each period's data was divided by year and by age.
Results: During Period 1 (14.21 years), there were a total of 1659 cases which met inclusion criteria. During Period 2 (7.98 years) 42 cases met inclusion criteria. There was an average difference of 111.5 cases per year (95% C.I. 91.0–132.1 cases per year) between the two time periods studied ($p < 0.00001$). In Period 1, 70.7% of the children meeting inclusion criteria were ≤2 years, while only 66.7% were ≤2 years old in Period 2.
Discussion: Most pediatric authorities believe children do not develop an understanding of death until age 3 or 4 years old and do not grasp the key concepts of death (irreversibility, nonfunctionality, universality) until they are 4 or 5 years old. Although rare, studies have found children as young as 4–5 years old expressing suicidal ideation. Therefore, most PCC cases coded with an exposure reason of ISS were incorrectly coded for children ≤2 years old and probably miscoded for children 3–5 years old. Reasons for miscoding vary but may be due to the location of ISS in the PCC's electronic medical record reason pick list. For cases in which the young child is truly suicidal, the PCC can override the rule's rejection of the case. From January 01, 2000 to March 09, 2022, 18.3 million exposure cases (36.2% of all exposure cases) occurred in children 2 years of age or younger; the 1230 ISS coding errors in this age group represent only 0.00067% of all exposure cases in this age group.
Conclusions: Implementing this NPDS edit has been highly effective in reducing erroneous coding of ISS for children <6 years old, and especially for those ≤2 years old. This example demonstrates how NPDS edits improve PCC data quality.

KEYWORDS AAPCC NPDS; NPDS edits; NPDS data quality

Alvin.bronstein@doh.hawaii.gov

12. Determining how effective radio public service announcements are at driving call volumes within the Navajo Nation

Jacqueline Kakos

New Mexico Poison and Drug Information Center, Albuquerque, NM, USA

Background: In New Mexico from 2013 to 2017, Native Americans had the highest number of poison-related deaths (26.6/100,000 population) when compared to other ethnic groups: Hispanics (26.5/100,000), Black/African Americans (24.4/100,000), Whites (21.2/100,000), and Asian/Pacific Islanders (4.7/100,000). In addition, the poison center has traditionally experienced low call volumes from tribal communities. A survey conducted in 2018 revealed that community health representatives of the Navajo Nation reported that their respective communities preferred printed materials and radio public service announcements (PSAs) as platforms to receive educational messages.
Methods: In 2021, a radio public service announcement (PSA) was developed in English and translated into Diné by a college of pharmacy student and a medical doctor, both fluent in their native tongue. The PSAs provide examples of poisoning scenarios and advises to call the poison hotline at the end. Thirty second versions of both the English and Diné PSAs were run on the Navajo Nation internet radio station, KTNN, for the month of September 2021, and then again for the month of March 2022. Both interventions had an equal amount of radio spots.
Results: Data were retrieved from Toxicall for zip codes that corresponded to the Navajo Nation in New Mexico. COVID calls were excluded from the data. Calls stemming from a poisoning outbreak that occurred on the Navajo Nation during the summer of 2020 were also eliminated to account for atypical patterns in call volume. There was a 48.3% increase in calls when comparing September 2021, intervention month, to September 2020. The March 2022 intervention showed a 54.5% uptick in calls when compared to March 2021. Both the September and March interventions resulted in an increase of 30 calls. To control for March also being poison prevention month in New Mexico, Navajo Nation zip codes were excluded, and then the total calls for the rest of the state were calculated. This resulted in 2147 calls in 2021 and 2073 in 2022.
Conclusions: The significant increase in call volumes when comparing the intervention months to the preceding years, strongly suggests that radio PSAs increase poison hotline traffic. Both intervention months showing an increase of 30 calls was also striking. In addition, total calls for the state without including the Navajo Nation zip codes dropped from March 2021 to March 2022, further eliminating poison prevention month as a cofactor in the increase in calls during the March intervention. Due to the consistent decrease in calls to poison centers across the nation, it is imperative to continue investigating how certain dynamics

influence call volume, such as increasing internet consumption and, perhaps, the COVID 19 pandemic. It is equally necessary to research other at-risk communities to refine the components of effective communication and to define relevant platforms for delivering those educational messages.

KEYWORDS Navajo Nation; radio; PSA

jkakos@salud.unm.edu

13. "Tranq dope" opioid overdose: clinical outcomes for emergency department patients with illicit opioid overdose adulterated with xylazine

Jennifer Love[a], Michael Levine[b], Kim Aldy[c], Jeffrey Brent[d], Alex Krotulski[e], Barry Logan[f], Carmen Vargas-Torres[a], Paul Wax[g] and Alex Manini[a]; On behalf of the ToxIC Fentalog Study Group

[a]Icahn School of Medicine at Mount Sinai, New York, NY, USA; [b]University of California, Los Angeles, Los Angeles, CA, USA; [c]UT Southwestern, Dallas, TX, USA; [d]School of Medicine, University of Colorado, Denver, CO, USA; [e]The Center for Forensic Science Research and Education, Willow Grove, PA, USA; [f]Center for Forensic Research and Education, Willow Grove, PA, USA; [g]University of Texas Southwestern, Paradise Valley, AZ, USA

Background: Illicit opioids, now consisting primarily of fentanyl and a variety of adulterants, are the primary cause of drug overdose (OD) fatality in the US. Xylazine, or "Tranq," is an alpha-2 agonist used as a veterinary tranquilizer that is being increasingly detected among decedents after an OD of illicit opioids; however, clinical outcomes in non-fatal OD involving xylazine are unclear. We compared clinical outcomes for emergency department (ED) patients with illicit opioid OD who were positive for xylazine to those who were negative for xylazine.
Methods: This multicenter, prospective cohort study enrolled adult (>18) patients with suspected opioid OD who presented to one of nine participating EDs in the US over 1 year. Waste serum from each patient was analyzed via liquid chromatography quadrupole time-of-flight mass spectroscopy (LC-MS) to detect all current illicit opioids, fentanyl analogues, adulterants, and xylazine. Patients without available waste serum or without illicit opioids detected were excluded. Medical record data were abstracted and entered into a RedCap database for analysis. The OD severity outcomes of interest were: (a) cardiac arrest requiring CPR (primary); and (b) coma within 4 h of arrival (secondary). Univariate analysis and multivariable logistic regression were performed using Stata v17. Central IRB approval was granted with waiver of consent.
Results: Out of 1166 patients screened, 845 were excluded, leaving 321 patients for analysis (90 xylazine, 231 non-xylazine), who were 69.5% male and median age 39. The primary outcome occurred in 37 patients, and the secondary outcome occurred in 111 patients. Most patients received at least one dose of naloxone (77.8% xylazine, 84.4% non-xylazine). CNS-related clinical outcomes were more common in both groups compared to cardiovascular-related clinical outcomes. Univariate analyses comparing clinical outcomes for xylazine and non-xylazine patients are summarized in. After controlling for multiple confounders (age, sex, race, prior psychiatric history, initial ED blood pressure, naloxone received), patients with xylazine had a significantly lower odds of cardiac arrest (OR 0.30, 95% CI 0.10–0.92) and coma (OR 0.52, 95% CI 0.29–0.94).
Conclusions: In this large multicenter cohort study, clinical outcomes for ED patients with illicit opioid OD were significantly less severe in those testing positive for xylazine. Because quantitative serum concentrations were not evaluated in this study, future studies should focus on the relationship between relative xylazine and illicit opioid serum concentrations.

KEYWORDS Xylazine; fentanyl; illicit opioids

jennifer.love@mountsinai.org

14. Brodifacoum-contaminated synthetic cannabinoid poisoning: a descriptive analysis

Justin Arnold[a], Prakash Mulay[b], Nikki Coble[b], Jemima Douge[a], Alfred Aleguas[a] and Alexandra Funk[c]

[a]Florida Poison Information Center Tampa, Tampa, FL, USA; [b]Florida Department of Health, Tallahassee, FL, USA; [c]Central Ohio Poison Center, Reynoldsburg, OH, USA

Background: In December 2021, an outbreak of coagulopathy associated with brodifacoum poisoning after synthetic cannabinoid (SC) use was identified. Given the combination of SC use and severe coagulopathy resembling a similar multistate outbreak in 2018, contamination of the SC with brodifacoum, a long-acting anticoagulant rodenticide (LAAR) was suspected.
Case series: On December 4, 2021, the Poison Control Center (PCC) identified a cluster of individuals who presented to local emergency departments with severe coagulopathy and bleeding. Most individuals described recent use of SC. Within 24 h, local and state health departments were notified to conduct epidemiological investigations and implement prevention strategies. Another PCC and the Centers for Disease Control and Prevention (CDC) assisted with initial testing and treatment plans. Testing for the specific LAAR and SC was performed by NMS Labs, which quickly identified brodifacoum as the contaminant. The Drug Enforcement Agency assisted in identifying 4-F-MDMB-BUTICA and ADB-BUTINACA as in four product samples as the SC that were contaminated. Patients with bleeding and coagulopathy (INR >8.5) were treated with fresh frozen plasma or 4-factor prothrombin complex concentrates and high doses of Vitamin K1 (10mg IV x1 and 50mg PO), followed by 50mg PO three times a day. Most patients improved within hours after initial treatment. Given the high cost of Vitamin K1 (about $50,000/month/patient) and lack of availability, there were challenges in arranging outpatient therapy for most patients due to lack of or underinsurance. Amneal Pharmaceuticals donated enough Vitamin K1 to treat all patients. Follow-up care was arranged for patients through a local health care assistance plan and federally qualified health centers as treatment was anticipated to last several months.
Discussion: In total, there are 54 cases that met the case definition for brodifacoum poisoning; 43 cases were confirmed with quantitative testing for brodifacoum and history of SC use, 11 cases were probable but lacked confirmatory testing. Six cases (11.3%) died. Cases had a median age of 38 years old and 40 (74.1%) were male. Seventeen (31.5%) cases were African American, 17 (31.5%) were Hispanic, and 13 (24.1%) were non-Hispanic white. The majority of patients ($n = 33$, 63%) were uninsured and 15 (27.8%) of patients were homeless. Many patients had multiple sites of bleeding which included hematuria (73.6%), hematemesis (30.2%), gingival bleeding (20.8%), rectal bleeding (18.9%), vaginal bleeding (11.3%), and ecchymosis (9.4%). Twenty-one (39.6%) patients were lost to follow-up. Additionally, for the first time, serial quantitative brodifacoum measurements were performed to guide the duration of therapy.
Conclusions: Identification of patient characteristics like homelessness, lack of insurance, and male predominance aided our timely response in identifying cases and engaging affected individuals in treatment. Additionally, leveraging partnerships

allowed for rapid identification of the adulterant, medication assistance, continued follow-up and care, and a robust epidemiologic assessment that allowed tailored interventions based on individual and population characteristics. Several lessons were learned that can assist PCCs and health care providers in responding to future LAAR coagulopathy events.

KEYWORDS Brodifacoum; synthetic cannabinoid; coagulopathy

jarnold25@gmail.com

15. False negatives in urine drug testing to inform screening, brief intervention and referral to treatment in elderly trauma patients

Stephanie Weiss[a], Laura Veach[b], William McGill[c] and Jeffrey Brent[d]

[a]NIDA, Baltimore, MD, USA; [b]Wake Forest School of Medicine, Winston-Salem, NC, USA; [c]Monalco Research, Port Washington, WI, USA; [d]School of Medicine, University of Colorado, Denver, CO, USA

Background: Trauma centers are recommended to screen hospitalized patients for substance use, briefly intervene, and refer to treatment (SBIRT). Relying on urine drug screen (UDS) immunoassays to screen traumatically injured patients underestimates their rate of other problematic substance use since many substances will not be detected. This is particularly problematic in elderly trauma patients, who may use illicit substances at lower rates than younger adults. Our objective was to estimate the types and rates of false negative (FN) results by UDS compared with comprehensive testing by liquid chromatography-mass spectrometry (LC-MS) in elderly trauma patients.
Methods: We performed a prospective cohort study of deidentified urine samples from adult level 1 and 2 trauma and burn activation patients. Samples were analyzed by a reference laboratory that performed both UDS and LC-MS comprehensive testing of >200 analytes. Medications given by the treating team were excluded from the FN count. Crosstab analyses were conducted for UDS versus LC-MS outcomes to establish the types and rates of FN results in elderly patients, defined as ≥65 years. We further dichotomized the results by creating a variable for "intentionality" (intentional injuries by self or others versus accidental injuries) and the nature of the traumatic event (severity, intentionality, type of trauma). Odds ratios for the type of traumatic event by substance were generated for the elderly subclass.
Results: 34 total urine samples meeting inclusion criteria were analyzed. Demographics: mean age = median age =76 (range 66–90+); female =18; white =32, black =2; injury severity (level 2 = 24; level 1 = 9; burn = 1); blunt/accidental trauma (n = 30; falls =23, motor vehicle collisions =7), penetrating/intentional trauma =3; alcohol present =2; total number FN/sample (zero =6, one =7, two =4, three =9, four =4, five =2, six =2). Psychoactive FNs were detected in 18/34 (52.9%), including antidepressants, antihistamines, anticonvulsants, opioids, benzodiazepines, and dextromethorphan. Nonpsychoactive FNs included acetaminophen n = 14; caffeine =10; nicotine =4. Compared with younger patients, elderly patients were more likely to be female (OR =2.41, CI =1.03–5.64); have higher trauma severity (OR =2.84, CI =1.14–7.05); have falls (OR =7.76, CI =3.10–19.93); have fewer motor vehicle accidents (OR =0.31, CI =0.12–0.81); experience fewer intentional/penetrating traumas (OR =0.001, CI =0.0003–0.0035); and use fewer illicit substances (OR =0.025, CI =0.003–0.196). No statistically significant associations with trauma were found for alcohol, antihistamines, gabapentin, or opioids. The "number needed to test," NNT =1.86 (TP = true positives).
Conclusions: Our prospective study verifies that, compared to younger adults, elderly trauma patients are predominantly female, sustained more blunt trauma (especially falls) and less penetrating trauma, and had less illicit substance use. Hospitalized geriatric trauma patients are frequently taking multiple medications known to be hazardous in this patient population that could contribute to their trauma injury morbidity, including propensity to fall. Based on these results, expansion of SBIRT to include polypharmacy and medication misuse in the elderly appears to be warranted.

KEYWORDS Urine drug screens; false negatives; polypharmacy

stweiss2@gmail.com

16. Characteristics of fatal poisonings among infants and young children in the US

Christopher Gaw[a], Allison Curry[a], Kevin Osterhoudt[b], Joanne Wood[a] and Daniel Corwin[a]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]Children's Hospital of Philadelphia, Philadelphia, PA, USA; [b]Poison Control at CHOP, Philadelphia, PA, USA

Background: Fatal poisonings are a preventable cause of death among infants and young children. Understanding the factors surrounding these deaths can inform future prevention efforts. Information from Child Death Reviews (CDRs) present an opportunity to improve our understanding of fatal pediatric poisonings, as the data collected from this source is unique compared to current surveillance systems used for toxicology research, such as the National Poison Data System (NPDS) or the Toxicology Investigators Consortium Registry. The objective of this study was to describe the characteristics of fatal pediatric poisonings using data obtained from CDRs.
Methods: We acquired data from 40 states participating in the National Fatality Review-Case Reporting System on deaths attributed to poisonings among children ≤5 years of age between 2005 and 2018. We analyzed select demographic, supervisor, death investigation, and substance-related variables using descriptive statistics. We also characterized the proportion of all deaths reviewed by CDRs that were attributed to opioid exposures by year.
Results: During the study period, 731 poisoning-related fatalities were reported by CDRs to the NFR-CRS. Over two-fifths of fatalities (42.1%) occurred among infants <1-year-old, and most fatalities (60.7%) occurred in the child's home. Ninety-seven children (13.3%) had an open child protective services case at time of death. Most children (70.6%) were supervised at the time of the incident. The most common primary supervisor documented was a biological parent (58.5%), followed by a grandparent (10.9%) or other relative (5.5%). Nearly three-tenths (28.5%) of children were in sight of the supervisor at the time of the incident. Two-thirds (66.6%) of fatalities did not have a documented call to a Poison Control Center. Opioids (n = 346, 47.3%) were the most common substance contributing to death, followed by over-the-counter pain, cold, and allergy medications (n = 108). Opioids were documented as contributing to death in 34.1% of poisoning fatalities among infants <1 year of age (105 of 308), 61.4% among children 1-year-old (105 of 171), and 54.0% among children 2–5 years of age (136 of 252). Infants <1 year of age were most commonly involved in death cases where amphetamines (81.3%, 26 of 32), cocaine (84.0%, 21 of 25), and alcohol (61.5%, 8 of 13) were documented as contributing to death. Opioids accounted for 24.1% of the substances contributing to deaths in 2005 compared to 52.2% in 2018.

Conclusions: Opioids, followed by over-the-counter cough, cold, and allergy medications, were the most common substances contributing to fatal poisonings among young children. CDRs reported an increasing proportion of opioid-related poisoning deaths over the study period. The CDR records more pediatric poisoning death cases than the NPDS. These data highlight the importance of tailored prevention measures to reduce fatal child poisonings, especially those focused on opioid response and education.

KEYWORDS Death review; pediatric; opioid

chris.e.gaw@gmail.com

17. Changes in bites and stings treated at emergency departments during the COVID-19 pandemic

Kelly Hogue[a] and Mathias Forrester[b]

[a]North Texas Poison Center, Midlothian, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: After the COVID-19 pandemic was declared in March 2020, various states began to enact stay-at-home orders and close or restrict various facilities. As a result of this disruption to people's lives, the pattern of injuries experienced by the population changed. Studies have reported increases in dog bites treated at pediatric hospitals and scorpion stings managed by poison centers. The objective of this study was to compare the pattern of bites and stings treated at US (US) emergency departments (EDs) in 2020 to those in 2019.
Methods: Cases were bites and stings during 2019–2020 obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from a sample of approximately 100 US hospital EDs. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. Cases were selected by identifying all records with mention of a bite, sting, or attack in the Narrative field and noting the type of animal involved. The national estimated number of injuries during 2020 was compared to 2019.
Results: An estimated 52,222 bites and stings were treated at US EDs during 2020, a decrease of 19.6% from 2019 ($n = 64{,}940$). For the most common types of animals, the estimated number of insect bites and stings decreased by 31.2% (27,659 in 2019, 19,036 in 2020), dog bites decreased by 4.4% (19,659 in 2019, 18,795 in 2020), tick bites decreased by 20.5% (3319 in 2019, 2638 in 2020), spider bites decreased by 30.9% (3303 in 2019, 2283 in 2020), cat bites decreased by 24.9% (2237 in 2019, 1679 in 2020), snake bites increased by 3.5% (1787 in 2019, 1849 in 2020), rodent bites decreased by 18.1% (1627 in 2019, 1332 in 2020), and scorpion stings increased by 22.8% (916 in 2019, 1125 in 2020). The estimated number of patients in 2020 age 0–5 years decreased 20.6% (5654 in 2019, 4491 in 2020), 5–12 years decreased 16.4% (6315 in 2019, 5276 in 2020), 13–19 years decreased 27.7% (6084 in 2019, 4400 in 2020), and 20 years and older decreased 18.8% (46,887 in 2019, 38,055 in 2020). The estimated number of injuries that occurred at home decreased 25.0% (37,756 in 2019, 28,324 in 2020), at a place of recreation or sports decreased 14.7% (7846 in 2019, 6694 in 2020), at other public property decreased 17.9% (5154 in 2019, 4232 in 2020), on a street or highway decreased 14.1% (1976 in 2019, 1698 in 2020), and at school decreased by 63.5% (323 in 2019, 118 in 2020).
Conclusions: The change in the estimated number of bites and stings varied by type of animal, patient age, and location where the incident occurred. A limitation to this study is that the NEISS database is intended to collect data on consumer product-related injuries. The database would only include bites and stings if a consumer product also was involved and thus would not include all bites and stings.

KEYWORDS Bites; stings; COVID-19

kelly.hogue@phhs.org

18. A 10-year review of insulin-related enquiries to the UK National Poisons Information Service

Emma Moyns[a], Robin E. Ferner[a], Euan A. Sandilands[b], Laurence A. Gray[c], Ruben H. K. Thanacoody[d] and Sally Bradberry[a]

[a]National Poisons Information Service (Birmingham Unit), Birmingham, UK; [b]National Poisons Information Service (Edinburgh Unit), Edinburgh, UK; [c]National Poisons Information Service (Cardiff Unit), Cardiff, UK; [d]National Poisons Information Service (Newcastle Unit), Newcastle, UK

Background: More than 4.9 million people in the UK have diabetes and sufferers are at increased risk of depression [1]. We wished to establish the frequency of enquiries involving insulin reported to the UK National Poisons Information Service (NPIS).
Methods: Retrospective analysis of enquiries between November 1, 2011 and October 31, 2021.
Results: We received 1195 enquiries involving insulin; 885 (74%) originated from non-hospital sources. There were 310 enquiries from hospitals about insulin with other substances ($n = 130$), or alcohol ($n = 11$), or alone ($n = 169$). Our analysis focusses on these 169 patients. Patients aged ≥18 years accounted for 88% of enquiries (range 1 day–87 years), and 100 (59%) were women. Ninety-eight patients were known to have diabetes: type 1 (T1D) in 32, type 2 (T2D) in 10, and the precise type undocumented in 56. There were 34 non-diabetic patients, and 37 whose diabetic status was unknown. Most exposures were intentional ($n = 114$, 68%) but some arose from therapeutic error ($n = 28$), were accidental ($n = 16$) or unknown ($n = 11$). The type of insulin was known in 151 cases: ultrashort-acting ($n = 35$), short-acting ($n = 14$), medium-acting ($n = 24$), long-acting ($n = 71$), and canine ($n = 7$). Where two or more insulin types or mixtures were involved ($n = 55$, 32.5%), the longest-acting component was counted. Most cases involved injection ($n = 153$, 90.5%), 13 involved ingestion, two skin or eye contact and one administration via a total parenteral nutrition line. The 15 cases of ingestion, skin, or eye contact required no treatment. In the remaining 154 cases, treatments given prior to contacting the NPIS were IV glucose ($n = 91$, 54%), glucagon ($n = 26$, 15%), octreotide ($n = 6$, 4%) and corticosteroids ($n = 2$, 1%). No patient had surgical excision of the injection site. Long-acting insulins accounted for 5/6 cases where octreotide was given. The lowest recorded blood glucose concentration at the time of the enquiry was in the range 0–0.9 ($n = 7$), 1.0–1.9 ($n = 29$), 2.0–2.9 ($n = 25$), 3.0–3.9 ($n = 12$), > 4.0 ($n = 14$). Hypokalaemia (defined as K+ < 3.5 mmol/L) was noted in 26 ($n = 15\%$) enquiries. The maximum Poisoning Severity Score [2] ($n = 162$) was: none ($n = 55$), minor ($n = 29$), moderate ($n = 44$), and severe ($n = 34$). The largest reported dose was an intentional subcutaneous overdose of 20,000 units of insulin aspart with an unknown amount of insulin detemir in a patient with T2D. At 7 h post injection the patient was being managed by 10% glucose infusion with nadir blood glucose of 2.8 mmol/L. The total duration of treatment and outcome are unknown.
Conclusions: Insulin-related enquiries to the NPIS typically involved intentional injection of insulin. Approximately half these

patients ($n = 53\%$) had diabetes. Hypoglycaemia was mostly managed satisfactorily by intravenous glucose infusion, with intramuscular or intravenous glucagon used occasionally. The place of octreotide and corticosteroids was unclear. Approximately 20% of cases were severe, especially with medium- and long-acting insulins; we recorded no fatalities.

KEYWORDS Insulin; poison center; epidemiology

e.moyns@nhs.net

19. "I'll huff, and I'll puff, and I just might blow my mind!" – inhalational abuse and misuse of halocarbon propellants reported to poison centers

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas Health – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Freon™ and other propellants are fluorinated hydrocarbons widely used in consumer products, including aerosols such as computer duster sprays. Intentional inhalation of volatile substances affects the cardiovascular, respiratory, and central nervous systems. Severe cardiac and neurologic toxicity includes the possibility of dysrhythmias, syncope, seizures, and death. This study describes inhalant abuse of Freon and other propellants reported to US poison centers.
Methods: Cases were exposures to Freon and other propellants (Generic code 0065000) reported during 2000–2020 to the National Poison Data System (NPDS), a database that receives data from all US poison centers. The exposure route was inhalation, and the exposure reason was intentional abuse and misuse. The distribution of total cases was determined for patient demographics and exposure circumstances. In addition, the distribution of cases not involving other substances was determined for management and outcome.
Results: Of 15,923 total cases, 14,204 (89.2%) were intentional abuse, and 1719 (10.8%) were intentional misuse. The annual number of cases increased from 213 in 2000 to 1228 in 2010 and then decreased to 494 in 2020. The patient age distribution was 28 (0.2%) 0–5 years, 651 (4.1%) 6–12 years, 6054 (38.0%) 13–19 years, 3850 (24.2%) 20–29 years, 2635 (16.5%) 30–39 years, 1478 (9.3%) 40–49 years, 598 (3.8%) 50 years and older, and 629 (4.0%) unknown age. Regarding gender, 10,607 (66.6%) of the patients were male, 5182 (32.5%) female, and 134 (0.8%) unknown gender. The exposure site was 11,215 (70.4%) patient's own residence, 1382 (8.7%) public area, 781 (4.9%) school, 438 (2.8%) other residence, and 2107 (13.2%) other and unknown locations. No other substances were reported in 14,629 (91.9%) of the cases. Of these 14,629 cases, 10,003 (68.4%) of the patients were already at or en route to a healthcare facility, 2315 (15.8%) were referred to a healthcare facility by the poison center, 1757 (12.0%) were managed on site, and 554 (3.8%) were managed at other or unknown locations. The medical outcomes were 2799 (19.1%) no effect, 3234 (22.1%) minor effect, 4006 (27.4%) moderate effect, 520 (3.6%) major effect, 68 (0.5%) not followed-judged nontoxic, 1587 (10.8%) not followed-minimal clinical effects possible, 1964 (13.4%) unable to follow-potentially toxic, and 288 (2.0%) unrelated effect. There were 163 (1.1%) deaths reported. A clinical effect was reported in 10,093 (69.0%) of the 14,629 cases not involving other substances. The most frequently reported clinical effects were syncope ($n = 2026$, 13.8%), tachycardia ($n = 1874$, 12.8%), drowsiness/lethargy ($n = 1558$, 10.7%), confusion ($n = 1023$, 7.0%), dizziness/vertigo ($n = 933$, 6.4%), hypertension ($n = 866$, 5.9%), vomiting ($n = 825$, 5.6%), agitation ($n = 687$, 4.7%), and nausea ($n = 667$, 4.6%). The most commonly reported treatments were fresh air ($n = 3569$, 24.4%), intravenous fluids ($n = 1061$, 7.3%), oxygen ($n = 700$, 4.8%), and dilute/irrigate/wash ($n = 685$, 4.7%).
Conclusions: Freon and other propellant cases increased from 2000 to 2010 then declined from 2010 to 2020. Most cases were intentional abuse involving adolescents, males, and did not involve other substances. The majority were managed at a healthcare facility with minor to moderate outcomes, although 163 deaths occurred.

KEYWORDS Freon; halocarbon propellants; inhalation

hinojosam4@uthscsa.edu

20. Changes in pepper spray exposures during the COVID-19 pandemic

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Pepper spray (capsaicin, Oleoresin capsicum [OC]) is a riot control agent for law enforcement use and is available to the public for personal protection. Its nonlethal, immediate, intended effects cause temporary immobilization by inducing lacrimation, painful contact dermatitis, and respiratory tract irritation. After the COVID-19 pandemic was declared in March 2020 in the US, states began to enact social distancing strategies and associated enforcement policies. These measures suggest a decrease might be expected in reported pepper spray exposures. Nevertheless, a second national crisis of widespread racial equality protests emerged in US cities in May 2020 with reports of pepper spray use. This study aimed to identify pepper spray exposures reported to US poison centers in 2020 compared to 2018 and 2019.
Methods: Data were obtained from the National Poison Data System (NPDS), containing all US poison centers. Cases were pepper spray exposures (Generic code 0201032 – Capsicum defense spray) reported to the NPDS during 2018–2020. We compared the number of pepper spray exposures reported in 2020 to those reported during 2018 and also to 2019.
Results: During 2020, 2357 pepper spray exposures were reported, a 22.8% decrease from 2018 ($n = 3054$) and 18.9% from 2019 ($n = 2908$). There were 1295 patients age 0–19 years during 2020 (29.6% decrease from 1840 in 2018, and 23.1% decrease from 1683 in 2019), 262 patients aged 20–29 years during 2020 (13.5% decrease from 303 in 2018, and 10.9% decrease from 294 in 2019), and 516 patients age 30 years or older during 2020 (10.9% decrease from 579 in 2018, and 9.3% decrease from 569 in 2019). The exposure was unintentional for 1951 patients during 2020 (19.5% decrease from 2424 in 2018, and 14.4% decrease from 2278 in 2019) and intentional for 79 patients during 2020 (45.1% decrease from 144 in 2018, and 36.3% decrease from 124 in 2019). The exposure site was the patient's residence for 1734 patients during 2020 (8.7% decrease from 1899 in 2018, and 0.1% decrease from 1735 in 2019), school for 109 patients during 2020 (80.7% decrease from 565 in 2018, and 79.9% decrease from 542 in 2019), and public area for 167 patients during 2020 (8.2% decrease from 182 in 2018, and 13.5% decrease from 193 in 2019). The management site during 2020 for 1762 patients was on site (11.8% decrease from 1997 in 2018, and 13.5% decrease from 2036 in 2019) and already at, en route to, or referred to a

healthcare facility for 479 patients during 2020 (30.6% decrease from 690 in 2018, and 31.5% decrease from 699 in 2019).
Conclusions: While the number of pepper spray exposures decreased in 2020 compared to 2018 and 2019, the decrease varied among subgroups. The percent decline was higher for patients aged 0–19 years, intentional and at school exposures, and patients managed at healthcare facilities. The social distancing mandates suggest that despite the rise in race inequality protests during and after May 2020, the decrease in exposures consistently declined.

KEYWORDS Pepper spray; COVID-19; riot control agent

hinojosam4@uthscsa.edu

21. Antidepressant exposures associated with exploratory behavior among young children reported to US poison control centers, 2000–2020

Matilda Francis[a], Henry Spiller[b], Jaahnavi Badeti[c], Marcel Casavant[b], Nichole Michaels[c], Motao Zhu[c] and Gary Smith[c]

[a]Eastern Virginia Medical School, Norfolk, VA, USA; [b]Central Ohio Poison Center at Nationwide Children's Hospital, Columbus, OH, USA; [c]Center for Injury Research and Policy, The Abigail Wexner Research Institute of Nationwide Children, Columbus, OH, USA

Background: Unintentional poisoning is the eighth leading cause of emergency department visits among children aged 0–5 years of age. Most unintentional poison exposures occur at home and involve pharmaceuticals. This study investigates characteristics and trends of antidepressant exposures among children younger than 6 years of age related to exploratory behavior reported to US poison control centers using the National Poison Data System (NPDS) from 2000 through 2020.
Methods: This study analyzed data from the NPDS from 2000 to 2020. US Census Bureau population estimates for 2000–2019 were utilized to calculate rates of exposure. Descriptive analysis and trend analysis were conducted.
Results: There were 215,909 first-ranked unintentional exploratory exposures involving antidepressants among children <6 years old during the 21-year study period, averaging 10,281 annually. Most cases were <3 years old (77.8%), involved a single substance (86.9%), and did not receive treatment at a health care facility (57.6%); however, 7.9% were admitted and 3.4% had serious medical outcomes, including 13 deaths. SSRIs were involved in 56.9% of all cases. Compared with SSRIs, TCAs (OR: 3.74, 95% CI: 3.44–4.07), SNRIs (OR: 2.39, 95% CI: 2.11–2.71), and lithium salts (OR: 2.00, 95% CI: 1.63–2.46) were more likely to be associated with a serious medical outcome. TCAs were the first-ranked substance in 7 of the 13 deaths. The rate of a serious medical outcome increased during the study period ($p < 0.0001$); however, the rate of HCF admission remained relatively constant.
Conclusions: On average, over 10,200 first-ranked unintentional antidepressant exposures related to pediatric exploratory behavior were reported annually to US poison control centers during the 21-year study period. Although most exposures were inconsequential, an important minority of cases required admission to a HCF or had a serious medical outcome, including 13 deaths. Additionally, the rate of serious outcome rose over the study period. Increased efforts to prevent these unintentional exploratory exposures among young children are needed, including public education and improved medication packaging.

KEYWORDS Antidepressants; unintentional; poisoning

francim@evms.edu

22. Carbon monoxide exposure due to electrical generators treated at emergency departments

Maximillian Avila[a], Alba Caceres-Munoz[a], Arpan Patel[b], Alexander Casanova[b], Todd Phillips[c], Kurt Kleinschmidt[d] and Mathias Forrester[e]

[a]North Texas Poison Control, Fort Worth, TX, USA; [b]North Texas Poison Center, Dallas, TX, USA; [c]UT Southwestern, Dallas, TX, USA; [d]University of Texas Southwestern Medical Center, North Richland Hills, TX, USA; [e]Independent Researcher, Austin, TX, USA

Background: One source of carbon monoxide exposures is electrical generators, particularly if they are placed too close to or inside the home. The objective of this study was to characterize carbon monoxide exposures due to electrical generators managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify carbon monoxide exposures due to electrical generators reported during 2000–2020, records with the code 0606 (Generators or power plants) in any product code field or the letter combination "generator" in the record narrative were reviewed, and those that appeared to be carbon monoxide exposures due to electrical generators were included in the study. The distribution of estimated exposures was determined by various factors.
Results: In total, 654 carbon monoxide exposures due to electrical generators were identified, resulting in a national estimate of 25,203 exposures. There were 5667 (22.5%) estimated exposures during 2000–2006, 5741 (22.8% during 2007–2013, and 13,795 (54.7%) during 2014–2020. There were 4210 (16.7%) estimated exposures during February-April, 3354 (13.3%) during May-July, 12,272 (48.7%) during August-October, and 5367 (21.3%) during November-January. The patient age distribution was 2470 (9.8%) 0–5 years, 3264 (12.9%) 6–12 years, 3425 (13.6%) 13–19 years, 2972 (11.8%) 20–29 years, 3357 (13.3%) 30–39 years, 2962 (11.8%) 40–49 years, and 6754 (26.8%) 50 years or older; 12,695 (50.4%) of the patients were male and 12,508 (49.6%) female. The patient race was 8314 (33.0%) white, 4178 (16.6%) black/African American, 1529 (6.1%) other, and 11,182 (44.4%) not stated. The location of the incident was 22,881 (93.1%) home or mobile home, 915 (3.7%) other public property, 478 (1.9%) place of recreation or sports, 310 (1.3%) farm or ranch, and 6 (0.0%) school. Of the 22,881 estimated exposures that occurred at the home or mobile home, in 5963 (26.1%) the generator was in the garage, 3659 (16.0%) basement, 2629 (11.5%) outside (unspecified), 2612 (11.4%) inside (unspecified), 1910 (8.3%) other (specified), and 6108 (26.7%) unknown. The most commonly reported clinical effects were 24,603 (97.6%) anoxia, 7779 (30.9%) headache, 7257 (28.8%) nausea, 2749 (10.9%) vomiting, and 2606 (10.3%) dizziness/light-headed. The patient disposition was 18,674 (74.1%) treated or examined and released, 2535 (10.1%) treated and transferred to another hospital, 2957 (11.7%) treated and admitted for hospitalization, 538 (2.1%) held for observation, 477 (1.9%) left without being seen/against medical advice, 6 (0.0%) fatality, and 15 (0.1%) not recorded.
Conclusions: Over half of the estimated carbon monoxide exposures due to electrical generators treated in EDs occurred during 2014–2020 and almost half occurred during August–October. The majority of the estimated exposures occurred at home or mobile

homes; of these, the generator was most often located in the garage or basement. Most patients were treated or evaluated and released from the ED.

KEYWORDS Carbon monoxide; generators; emergency department

maximillianavila@gmail.com

23. Comparative outcomes of F(ab')$_2$AV and FabAV for rattlesnake envenomations: a retrospective poison center study

Garret Winkler[a], Justin Seltzer[a], Nate Friedman[a], Timothy Albertson[b], Rais Vohra[c], Craig Smollin[d], Richard Clark[e] and Daniel Lasoff[a]

[a]VA San Diego Health Care, UC San Diego Health, San Diego, CA, USA; [b]California Poison Control System (Sacramento Division), UC Davis, Davis, CA, USA; [c]California Poison Control System (Fresno/Madera Division), UCSF Fresno, Fresno, CA, USA; [d]San Francisco, California Poison Control System (San Francisco Division), University of California, San Francisco, CA, USA; [e]California Poison Control System (San Diego Division), UC San Diego Health, San Diego, CA, USA

Background: Crotalid, or pit viper, envenomations are commonly reported in the US, roughly 25% of which are caused by rattlesnakes. California has multiple native crotalid species, all of which are rattlesnakes. Symptomatic rattlesnake envenomations are often treated with antivenom. Currently, two antivenoms are available in the US: Crotalidae-polyvalent ovine immune FabAV (trade name CroFab®) and Crotalidae equine immune F(ab')$_2$AV (trade name ANAVIP®). While the two antivenoms have been compared in clinical trials, few real-world comparisons are available.
Methods: This is a retrospective study of rattlesnake envenomations referred to the California Poison Control System (CPCS) between October 2018, when F(ab')$_2$AV first became commercially available, to January 2021. All CPCS patients who were treated for a rattlesnake bite with antivenom during that period were included. Individual patient records were reviewed and relevant demographics, clinical presentation, antivenom use, and adverse event data were analyzed.
Results: 208 patients were included: 193 received FabAV, twelve received F(ab')$_2$AV, and three received both. Most patients in each group had localized swelling/edema, pain, and numbness/tingling/paresthesias. A total of 15 adverse events were reported, all of which occurred in the FabAV group. No serious adverse events or deaths occurred.
Conclusions: The different manufacturing processes may explain the observed adverse event rates. FabAV cleavage produces whole Fc regions, which are still immunologically active but are usually removed in the production process. F(ab')$_2$ cleavage damages the Fc region, making it less immunologically active. This is consistent with our reported rate of adverse events, though these findings are limited by the small F(ab')$_2$AV cohort and retrospective format. Our study included more patients treated with FabAV but all adverse events were reported in that group. Either treatment can be considered for symptomatic rattlesnake envenomations, with particular attention paid to potential adverse effects affecting those receiving FabAV (CroFab).

KEYWORDS Anavip; CroFab; antivenom

gwink3@gmail.com

24. An outcome comparison of diphenhydramine and hydroxyzine cases from a poison center

Curtis Elko[a] and Tahnee Bridgford[b]

[a]Washington Poison Center, Seattle, WA, USA; [b]School of Pharmacy and Health Professions, Creighton University, Omaha, NE, USA

Background: Overdose with either diphenhydramine (DPH) or hydroxyzine (HDX) may lead to agitated delirium, seizures and cardiovascular effects, yet DPH retains over-the-counter (OTC) status while HDX is prescription-only. This study compares overdose outcomes of two similar drugs with differing prescribing status.
Methods: DPH-only and HDX-only cases were identified in the poison center ToxiCALL(R) database for the years 2019 through 2021 and included if managed at health care facility and if age $\geq$12 years old. Fields exported were age, reported dose, clinical effects, treatment, outcome severity and duration. Dose was calculated as the estimated numbers of tablets times the milligram amount. Where a dosage amount was not found, 25 mg was used for DPH and 10 mg was used for HDX. Cases without doses were excluded. Average DPH and HDX doses for each outcome (no effect, minor, moderate, major) were tested for a difference using a *t*-test. Severity outcomes for No Effect and Minor were combined into a "less severe" category while the Moderate and Major severity outcomes were combined into a "more severe" category. Odds ratios for more or less severe categories were computed for DPH versus HDX in the following dosing ranges: 0–500 mg, 501–1000 mg, 1001–1500 mg, > 1500 mg and tested for statistical significance.
Results: DPH and HDX cases [*n*] with average (μ) milligram (mg) doses ± Standard Deviation with *t*-test for significant μ differences ($p < 0.05$) were as follows: No Effect (DPH [50], μ = 525 ± 518mg; HDX [50], μ = 551 ± 586mg; $p = 0.82$), Minor (DPH [130], μ = 561 ± 593 mg; HDX [139], μ = 624 ± 592 mg; $p = 0.38$) Moderate (DPH [287], μ = 1074 ± 1370 mg; HDX [96], μ = 1101 ± 1121 mg; $p = 0.87$) or Major (DPH [26], μ = 3043 ± 3003 mg; HDX [1], 10,000 mg, μ unavailable), and All Outcomes (DPH [493], μ = 987 ± 1402 mg; HDX [96], μ = 804 ± 1001 $p = 0.035$). Overall, more severe cases ($n = 410$) were commonly comprised of cardiovascular effects (tachycardia =71%, QTc/QRS abnormalities =33%, hypertension = 38%, rarely hypotension = 2.4% or dysrhythmias =0.73%) and neurologic effects (agitation = 30%, hallucinations =25%, rarely: CNS depression, moderate-to-major =7% and any seizures =6.8%). Common treatments associated with more severe effects were benzodiazepines =34%, physostigmine =2%, propofol =3.4%, antipsychotics =2.4%, other sedation = 3.2%, anticonvulsants =0.49%, alkalinization (systemic) = 4.6% and ventilator =5%. Of the 97 more severe HDX cases,14% used benzodiazepines and 2% used alkalinization, but no HDX case had use of ventilator, propofol, physostigmine or anticonvulsants. Odds ratios (OR) with confidence interval (CI) for DPH having a more severe effect than HDX were calculated for the following dosing ranges: any milligram (mg) amount (OR 3.39; [95%CI 2.5, 4.6]; $p < 0.0001$), 0–500 mg (OR: 3.13 [95%CI 2.02, 4.85]; $p < 0.0001$) 501–1000 mg (OR: 3.19; [95%CI: 1.68, 6.06]; $p = 0.0004$), 1001 mg-1500 mg (OR: 10.31; [95%CI: 3.39, 31.36]; $p < 0.0001$), > 1500 mg (OR: 2.95; [95%CI: 1.15, 7.58]; $p = 0.0263$). The percentage of more severe cases with a duration of clinical effects >24 h was 27% for DPH and was 5% for HDX.
Conclusions: Estimating the average dose for a severity outcome is limited by the use of unconfirmed doses. However, this study demonstrated DPH having greater odds for a severe outcome (overall 2.5–4.6 times) than HDX. Further, DPH had 5-fold more cases of long duration (> 24 h) than HDX. This study suggests

HDX could be a safer alternative to DPH as an OTC drug in case of overdose.

KEYWORDS Diphenhydramine; hydroxyzine; safety

elko@wapc.org

25. Fatal propranolol overdoses reported to the UK National Poisons Information Service (NPIS) over 5 years, 2017–2021

Hayley Williams[a], Pardeep Jagpal[a], Sally Bradberry[a], Euan A. Sandilands[b], Laurence A. Gray[c] and Ruben H. K. Thanacoody[d]

[a]National Poisons Information Service, Birmingham, UK; [b]National Poisons Information Service (Edinburgh Unit), Edinburgh, UK; [c]National Poisons Information Service (Cardiff Unit), Cardiff, UK; [d]National Poisons Information Service (Newcastle Unit), Newcastle, UK

Background: Propranolol is widely prescribed in the management of medical conditions including migraine prophylaxis, anxiety, portal hypertension, thyrotoxicosis and tachyarrhythmias. Between 2007 and 2017 propranolol dispensing in the UK increased by some 41%. In the same period, deaths in England and Wales following propranolol overdose increased by 205%.
Methods: We retrospectively reviewed cases of fatal propranolol poisoning reported to the UK NPIS, between January 01, 2017 and December 31, 2021 to understand the demographics of these exposures, the doses involved and treatments administered.
Results: During this period, there were 1925 enquiries to the NPIS involving propranolol, all from healthcare professionals. There were 46 fatalities (aged 14–70 years) with 57% ($n = 26$) of them being less than 40 years of age, and the majority of these being female (77%; $n = 20$). Propranolol was the patient's own medication in 11 (24%) cases, was not their medication in one (2%) and in the remaining 34 (74%) cases it was not known if propranolol was the patient's own. For the 11 patients prescribed propranolol the therapeutic indication was documented in 6 (migraine $n = 4$ and anxiety $n = 2$). Thirteen cases involved propranolol only and in the 33 cases of mixed overdose the mean number of co-ingestants was two, with a maximum of 13. An antidepressant (venlafaxine, sertraline, mirtazapine, fluoxetine, citalopram, escitalopram, amitriptyline or clomipramine) was co-ingested in 21 cases. The reported dose of propranolol ingested was documented in 23 of 46 cases, median 3200 mg (IQR 1920–4,480 mg) and in three patients was more than 7000 mg. All cases were graded as "severe" at the time of enquiry. Cardiac arrest prior to contact with the NPIS was recorded in 41 of 46 cases. Fourteen (34%) cardiac arrests occurred in hospital and twenty-three occurred out-of-hospital (56%). In four cases (10%) the location of the cardiac arrest was not documented. Patients received the following treatments: sodium bicarbonate ($n = 30$, 65%), glucagon bolus and/or infusion ($n = 38$, 83%), high dose insulin/dextrose ($n = 36$, 78%), inotropes or vasopressors ($n = 36$, 78%), intralipid ($n = 25$, 54%) and ECMO was commenced in two cases. For high dose insulin/dextrose and intralipid these numbers represent a 38% increase in use following contact with the NPIS. The dose of insulin administered was known in 15 cases (median dose 4 unit/kg/h). Eight patients received a maximum dose of less than or equal to 4 unit/kg/h and doses more than or equal to 8 unit/kg/h were given in 7 cases (maximum 10 unit/kg/h in three cases).
Conclusions: Young adults particularly females accounted for the majority of propranolol-related fatalities. In almost half of all cases, an antidepressant was also ingested. Caution is needed when prescribing propranolol to these patients who may be at higher risk of self-harm. Healthcare professionals should be aware of the potential for rapid deterioration and severe clinical outcomes following propranolol overdoses. Rapid access to expert clinical advice is available through poison centres and is strongly recommended in order to optimise use of available treatments.

KEYWORDS Propranolol; overdose; poison centre

h.williams9@nhs.net

26. Use of tranexamic acid for venom-induced consumptive coagulopathy in a rabbit model of crotalidae envenomation

Gerald OMalley[a], Theodore Morrison[b], Andrew Schrader[b], Andrew McGowan[b], William Bianchi[b], Jarratt Lark[c], David Pardue[d] and Gregory Zarow[b]

[a]Sidney Kimmel School of Medicine of Thomas Jefferson University, Lansdale, PA, USA; [b]US Navy Medical Center San Diego, San Diego, CA, USA; [c]Grand Strand Medical Center/Team Health, Myrtle Beach, SC, USA; [d]Grand Strand Medical Center, Myrtle Beach, SC, USA

Background: *Crotalidae* envenomation causes venom-induced consumptive coagulopathy (VICC) and direct cytotoxicity, which frequently leads to disfiguration, loss of function and death. Treatment of severe cases has principally relied on antivenom administration. Tranexamic acid (TXA) has been used in other coagulopathies, with one mechanism being halting plasminogen activation and theoretically would be beneficial to minimize injury from VICC. TXA may provide a feasible adjunct to traditional treatment of severe VICC. Here, we developed a rabbit model to study whether intravenous (IV) TXA may ameliorate VICC from IV rattlesnake venom.
Methods: Eight rabbits were randomly assigned to venom only (4), venom + TXA ($n = 3$) or TXA only ($n = 1$). TEG samples were collected via arterial catheter, with a baseline sample obtained prior to venom administration. A venom solution, of *Crotalus adamanteus* venom at a dose of 0.1 mg/kg, was delivered intravenously over 3 min, followed immediately by TXA in the treatment group. Samples were collected at times of 0, 15, 30, 45 and 60 min after IV administration.
Results: TEG values reported were R (time to beginning of clot formation), and MA (maximum amplitude or clot strength). Venom-only group yielded R values of 7.10, 33.43, 65.90, 81.10 and 62.25 at baseline, T + 15, T + 30, T + 45 and T + 60; venom + TXA gave R of 9.43, 37.00, 42.76, 67.29 and 168.5, with no statistically significant difference. MA values for venom-only were 63.13, 9.68, 7.80, 3.58 and 3.58; venom + TXA MA values were 54.60, 11.70, 9.00, 3.33, and 2.10, again with no statistical difference between groups. TEG parameters from later in the clot cycle, such as LY30, were unmeasurable in the experimental group.
Discussion: In this pilot experiment, our results failed to demonstrate an impact of IV TXA immediately following IV administration of *crotalidae* venom as measured by TEG. There were no appreciable differences between control and treatment subjects in any of the 5 parameters reported by TEG. We report here on R and MA, as the parameters that occur later in the clot cycle were unmeasurable via TEG in the experimental group. This experiment is limited due to the small sample size, limitations of TEG to represent coagulation at the tissue level, and an experimental model which does not represent the typical manner of envenomation via intra- and subdermal tissue deposition.

Conclusions: In this pilot experiment, TXA failed to alter VICC caused by *Crotalus adamanteus* venom in a rabbit model of IV envenomation as measured by thromboelastography. Further experimentation using subcutaneous or intramuscular envenomation models may yield different results.

KEYWORDS Crotalid envenomation; tranexamic acid; VICC

geraldomalley@gmail.com

27. Acute severe withdrawal associated with 4-fluorophenibut and bromazolam exposure

Kathleen Chen[a], Linda Chamberlin[b], Damon Borg[c], Moira Davenport[a] and Matthew Stripp[a]

[a]Allegheny Health Network, Pittsburgh, PA, USA; [b]Drexel University College of Medicine, Philadelphia, PA, USA; [c]Cordant Health Solutions, Huntington, NY, USA

Background: Phenibut (β-Phenyl-GABA) is a GABAB receptor agonist discovered in Russia in the 1960s used for anxiolysis, insomnia, and depression. 4-fluorophenibut (β-(4-fluorophenyl)-GABA) is a phenibut derivative which has shown a higher GABAB receptor affinity in a murine model, which may lead to stronger intoxication. Bromazolam is a potent designer benzodiazepine encountered in the illicit market. We are reporting the first human exposure with associated severe refractory withdrawal after 4-fluorophenibut and bromazolam use resulting in long-term adverse neurologic outcome.
Case report: A 57-year-old male with a history of alcohol use disorder, depression, and anxiety presented to the emergency department (ED) with encephalopathy. Per his spouse, the patient was found down, verbally incoherent, incontinent of urine, with small bags of unidentified white powder and a small vial of unidentified clear liquid. He reportedly purchased these unknown sedative agents online. Two days prior, the patient had a brief relapse having consumed at least 1 pint of liquor after months of abstinence. Upon arrival to the ED, he responded to verbal and tactile stimuli. He could move all extremities spontaneously. Initial evaluation revealed a urine drug screen positive for benzodiazepines, normal non-contrast computed tomography head, and mildly elevated serum lactic acid. The patient was given two doses of naloxone and two doses of flumazenil, which resulted in mild mental status improvement. Sixteen hours after admission, the patient became increasingly agitated, restless, and tremulous, without myoclonus, diaphoretic, and febrile. Multiple doses of phenobarbital and lorazepam minimally improved his agitation. An electroencephalogram did not show seizure activity. After endotracheal intubation, scheduled diazepam and dexmedetomidine infusion were initiated. The patient's autonomic instability remained refractory to multiple sedatives including haloperidol, ziprasidone, and infusions of propofol, fentanyl, and midazolam. Concern for phenibut exposure was raised. The patient was initiated on a 29-day baclofen taper starting at 20 mg four times daily for suspected phenibut withdrawal. The white powder was confirmed by laboratory analysis as 4-fluorophenibut and the clear liquid was confirmed as bromazolam. The patient remained with hyperthermia, tachycardia, hypertension, and tachypnea throughout the course despite continued treatment with fentanyl, ziprasidone, lorazepam, hydralazine, and midazolam. Subsequent complications included intermittent autonomic instability, pneumonia, ventilator dependence, renal failure requiring dialysis, and right-sided weakness without evidence of ischemic stroke. He was weaned off baclofen on hospital day 36. The patient could follow commands and move all extremities by hospital day 55. Upon discharge to long-term care facility, the patient answered questions with head nod. He continued on a taper of diazepam.
Discussion: This case report characterizes a severe combined withdrawal syndrome from 4-fluorophenibut and bromazolam resulting in an adverse neurologic outcome. Despite initial withdrawal treatment, the patient continued to require high-dose sedation for profound autonomic instability and agitation.
Conclusions: Further study of the adverse effects secondary to 4-fluorophenibut toxicity and withdrawal is imperative.

KEYWORDS Phenibut; benzodiazepine; withdrawal

kathychen1787@gmail.com

28. Kratom withdrawal precipitated by naltrexone treated with buprenorphine

Matthew Zuckerman

University of Colorado School of Medicine, Denver, CO, USA

Background: Kratom *(Mitragyna speciosa)* is a rapidly emerging drug of abuse in the US. Kratom has been indicated to have stimulant effects in low doses and opioid agonist effects at higher doses. Mitragynine and 7-hydroxymitragynine are likely the main alkaloids in kratom responsible for its opioid agonist effects. Kratom is frequently used to treat symptoms of opioid withdrawal, however there is animal research and social media postings describing use for reducing alcohol abuse. Kratom use is associated with a withdrawal syndrome that includes increased aggression, lacrimation, muscle and bone aches, and jerky limb movements, and there are cases of precipitated withdrawal following naloxone administration. We report a case of precipitated withdrawal in a patient on chronic Kratom following administration of oral naltrexone.
Case report: A 46 year-old man presented to the emergency department via ambulance complaining of nausea and vomiting after taking naltrexone. He has a history of alcohol abuse and was prescribed naltrexone 50 mg orally for alcohol cessation. Symptoms began 30 min after taking the medication for the first time. Vital signs were notable for blood pressure of 134/84, heart rate of 78, RR of 24, 97% on RA. Blood glucose of 123 mg/dL. His last alcoholic drink was 12 months previously. His only daily medications include duloxetine 60 mg PO daily. Review of his medical chart and state prescription drug monitoring program confirmed no prior prescriptions for opioids. His pupils were dilated to 3 mm and reactive. Exam was notable for diaphoresis, yawning, and piloerection. Upon further questioning the patient stated that he used Kratom tea several times a day for over a year. He was not asked about Kratom use prior to naltrexone prescription and not warned about drug interactions. He received ondansetron 4mg IV from EMS. He had a COWS score of 21 and received clonidine 0.1 mg PO without improvement. Buprenorphine/naloxone 8 mg Sl was administered with an improvement to COWS score of 12. Follow up with the patient the following week suggested that he was not interested in opioid replacement therapy, and had stopped taking naltrexone for alcohol abuse.
Discussion: Kratom effects on alcohol use are believed to be mediated via mu opioid receptor agonism. Patients will frequently not report the use of kratom if not specifically asked. Precipitated withdrawal from naloxone has been described; however, as in this case, the use of naltrexone may lead to a prolonged withdrawal state. Buprenorphine has been described for treating opioid withdrawal symptoms in patients abstaining from chronic kratom use; however, it has not been described for acute kratom withdrawal in the emergency department.

Conclusions: Providers should screen patients about herbal supplement use prior to initiating opioid antagonists. Patients with alcohol abuse disorder may use kratom for treatment, or for co-occurring pain or opioid dependence syndromes. Providers should consider the use of opioid agonists in the setting of precipitated opioid withdrawal in patients taking kratom.

KEYWORDS Kratom; naltrexone; alcohol abuse

matthew.zuckerman@cuanschutz.edu

29. Cluster of ultraviolet radiation injuries due to damaged metal halide lamp at a family barbecue

Robert Feldman and Stuart Pine

Cook County Health, Chicago, IL, USA

Background: Metal halide arc lamps use an electrical arc across mercury and halide vapor to generate high intensity visible light; ultraviolet (UV) light is also produced and must be absorbed by a protective filter. We treated a cluster of 4 patients who presented with skin and eye irritation following a family barbecue. Reconstructing the layout of the gathering allowed us to localize and identify the source of exposure: a damaged 400 watt metal halide lighting fixture.
Case series: Four patients presented to our emergency department with facial erythema and eye pain. They had been at a family barbecue the evening before presentation, and said that there were at least two additional people with similar symptoms. The patients were concerned they had been exposed to chemicals from the barbecue smoke. All attendees had been under a tent canopy and had no significant sun exposure. Three of the patients had conjunctival injection without fluorescein uptake, one also had keratitis demonstrated by fluorescein staining. Carboxyhemoglobin and methemoglobin levels were measured for two patients and were normal. We plotted the positions of all six reportedly affected people within the tent. There was no correlation between symptoms and distance from the barbecue grill, nor with which foods were eaten. However, all the affected subjects had been facing the center of the tent. We obtained a photo of the tent's lighting unit, which was an unenclosed 400-watt metal halide fixture. The arc tube was bare and missing its outer UV protective glass shield bulb. The patients were treated with ocular lubricants and oral nonsteroidal anti-inflammatory medications and were discharged home.
Discussion: Metal halide arc tubes are efficient sources of high intensity white light, but also emit high-frequency UV-C, as well as lower-frequency UV-A radiation. In the cases presented, the unshielded arc tube emitted ultraviolet light, which caused the skin and eye burns. Safety self-extinguishing metal halide lamps that automatically turn off if the outer UV protective bulb is damaged are available and are recommended, but not mandated, by the FDA for open lighting fixtures. The ongoing availability of metal halide lamps that will function even without UV protection in place continues to present a risk of UV burns. As in the cases presented, patients may not recall anything unusual about their ambient lighting exposure, as the missing UV protection has no perceptible effect on the visible light emitted.
Conclusions: Patients seeking medical attention for possible toxic exposure causing irritation of exposed skin or the eyes should have their UV radiation exposure assessed. Medical professionals should consider the potential for these injuries to be caused indoors by defective metal halide arc lighting fixtures.

KEYWORDS Ultraviolet; radiation; photokeratitis

rfeldman@cookcountyhhs.org

30. Characteristics associated with utilization of a novel multidisciplinary outpatient snakebite clinic

William Rushton[a], Erin Ryan[a], Dag Shapshak[b] and Sukhshant Atti[b]

[a]Alabama Poison Information Center, Birmingham, AL, USA; [b]Department of Emergency Medicine, University of Alabama at Birmingham, Birmingham, AL, USA

Background: A multidisciplinary outpatient clinic was established in June of 2021 to provide follow-up care for snake envenomation patients after discharge from the hospital. The clinic is operated by medical toxicologists and wound care specialists and offers follow-up to any patient age 5 years or older within the state. Referrals to the clinic are facilitated through the state poison center during acute management of the envenomation, with specialists in poison information obtaining patient contact information for follow-up based on patient or caregiver interest. Patients are seen in clinic approximately 1 week after discharge from the hospital with additional follow-up as needed.
Methods: This was a retrospective review of snakebite cases reported to the state poison center between June 1, 2021 and December 31, 2021. Exclusion criteria were age <5 years, management outside of a hospital, not followed to known outcome, or death during hospitalization. Patients who followed up with the clinic were compared to those who did not in terms of demographics and clinical course using *t*-test for continuous variables and chi-squared test for categorical variables.
Results: Of 144 snakebite patients managed by the poison center, 115 met inclusion criteria, 15 (13%) of whom followed up in the clinic after discharge. Patients who opted for clinic follow-up were more frequently admitted to the ICU (73.3% vs 26%, $p < 0.001$) and tended to have moderate or major outcomes (86.7% vs 49%, $p = 0.006$). They were also more likely to receive opioids (80% vs 45%, $p = 0.011$) and antivenom (73.3% vs 46%, $p = 0.048$) during their acute management. More of the clinic patients had medical toxicologist involvement in their case during their hospitalization via consultations through the poison center (66.7% vs 33%, $p = 0.012$). Geographically, a larger percentage of clinic patients were treated in a hospital in the same or an adjacent county to the clinic location (46.7% vs 20%, $p = 0.023$) compared to those who did not follow up. There were no significant differences in patient age, gender, or species of snake between the clinic vs non-clinic patients.
Discussion: The newly established snakebite clinic allows for management of ongoing symptoms and potential complications during the post-discharge phase, filling a role that has often been left to providers without specific training in envenomations. While the clinic was utilized by only a minority of the patients managed through the poison center during its first 7 months of operation, patients were more likely to elect to follow up after a more severe envenomation. However, patients from more distant areas were less likely to be seen in clinic, suggesting ability to travel to the clinic location may be a limitation for some patients who might otherwise seek follow up care. Due to its involvement in the management of snake envenomations throughout the state, the poison center was instrumental in identifying eligible patients and connecting them with outpatient follow-up.
Conclusions: The creation of an outpatient follow-up clinic for snake envenomations based on poison center referrals allowed for expert care in the post-hospitalization period, especially in patients with more severe envenomations.

KEYWORDS Snakebite; envenomation; crotalid

wrushton@uabmc.edu

31. 13 Years of experience in educating SPIs for the CSPI exam

Carolyn Odom, Rebecca Tominack, Julie Weber and Theresa Matoushek

Missouri Poison Center, St. Louis, MO, USA

Background: Poison Centers are required to staff their hotlines with at least 50% Certified Specialists in Poison Information (CSPI) to maintain accreditation through the American Association of Poison Control Centers (AAPCC). Initial eligibility to become a CSPI requires a minimum of 1200 h work experience and 2000 calls. Once certified, the CSPI must retake the exam every 7 years to maintain certification. Preparation for the exam is an arduous task that includes dedicated study and review to enable recall from the broad spectrum of toxicology. In 2010 this poison center launched an in-house CSPI Exam Prep Series. We first reported on its success in an abstract at the 2012 North American Congress of Clinical Toxicology (NACCT) in Las Vegas, Nevada. We now provide an update on the current status of the series.

Discussion: The approach emphasizes a serial, methodical review of the material. The educational content was developed by the medical director and organized into 13 broad topics, which are presented weekly by teleconference in 2-h sessions. Each of 13 main handouts is provided to the attendees, as well as supplemental handouts that address overarching topics such as EKGs, acid-base balance, blood gas interpretation, and major electrolyte abnormalities. The series is intended to increase competence and satisfaction on the job, not to simply pass a test. Annual revisions to the 29 handouts are made by the medical director, based on changes in evidenced-based practices or AAPCC study topics. After the 2012 NACCT presentation, five interested poison centers inquired about allowing their exam candidates to participate in the review series. Beginning in 2013 other centers' exam candidates were invited to attend remotely. Over subsequent years, candidates from 18 poison centers throughout Canada, the US mainland, and Puerto Rico have participated. Most learned of the review through recommendations of colleagues who had previously attended. While the sponsoring center has never requested test scores or results as a condition for attendance, participating centers commonly volunteer their pass/fail rate. Passing rates have been overwhelmingly positive, affirming the success of this CSPI Exam Prep Series. The sponsoring center itself has had a 100% pass rate in 53 exam sittings since the inception of its program. Feedback for future improvement is obtained by surveying candidates after completion of the exam. Transformational changes, some resulting from survey responses, include Spanish translations of handouts (2018), recordings of presentations made available to attendees (2019), Zoom format instituted (2020), and presenters chosen from subject matter experts (2021). Innovations planned for 2023 include the addition of PowerPoint presentations to support the handouts.

Conclusions: While there have been changes to this poison center's CSPI Exam Prep Series over the years, the overarching goal remains – to equip CSPIs to deliver exceptional health care in their job performance. A successful program requires committed leadership, knowledgeable and enthusiastic presenters, and participants who are dedicated to learning and study. Course attendees overwhelmingly affirm that participation helped them to become better in their role as SPI.

KEYWORDS CSPI exam; SPI education; teleconference training

carolyn.odom@ssmhealth.com

32. Emergency medicine (EM) provider impressions of novel case-based toxicology module

Joseph Ebersole, Noah Askman, Peter Chai and Charlotte Goldfine

Brigham and Women's Hospital, Boston, MA, USA

Background: The diagnosis and treatment of toxicologic disorders is an area of core content that emergency medicine (EM) resident physicians and physician assistants (PA) are required to demonstrate competence in order to become proficient practicing clinicians. Despite this, a prior survey showed that 66% of residencies don't have access to a toxicology curriculum and only 29% of resident physicians respondents felt comfortable with toxicology concepts. EM providers may not encounter core toxicologic presentations clinically during their training, and even when EM programs have a required toxicology elective, they may not always cater to a variety of learning styles. Oftentimes, toxicology curriculums rely on didactics and textbooks or other traditional learning materials, which may achieve lower learning retention compared to case-based, participatory, and simulation based methods. Similarly, PA programs have limited to no formal toxicologic education and training. Even among EM postgraduate PA programs, a prior survey showed that only 43% offered a toxicology elective. With remote learning becoming more common, we aimed to develop a new asynchronous method of delivering key concepts in the form of short case-based modules and evaluate EM resident and PA perceptions of the learning tool.

Methods: We developed a case-based interactive module and survey using REDCap and distributed it to EM residents of post graduate year (PGY) 1–4 and PAs via email. Learners were given a sample case prompt followed by diagnostic and therapeutic data that had to be selected by the user, with automated feedback given based on user choices. After viewing the module, providers were asked about interest, preferred frequency, and clinical areas that were most amenable to teaching using this system. A System Usability Scale (SUS) was integrated into the survey to evaluate standardized usability.

Results: 55 participants responded to the survey, with 38 completing the module and survey in its entirety. Twenty-two respondents were PAs (PA 1: 4; PA 2: 5; PA 4+: 13) and 16 were EM residents (PGY 1: 5; PGY 2: 4; PGY 3: 3; PGY 4: 4). 15 respondents were male, 22 were female and 1 identified as non-binary. The sample was predominately white with an average age 33 years (range 25–48). Thirty-eight (100%) respondents indicated they would want to use the toxicology cases in its current format again. 11/16 (69%) residents preferred to receive cases daily on weekdays for a 2-week rotation while 13/22 (59%) of PAs preferred to receive the cases monthly. The SUS score for the module was 83.6/100 indicating high usability.

Conclusions: Both EM residents and PAs at various stages of training found this interactive case-based module to be highly usable and indicated that they would like to receive similar modules in the future. This method can be used to increase accessibility to toxicologic education that learners may prefer over traditional methods. Future studies will aim to disseminate this module and evaluate its efficacy in learning retention and long-term usability.

KEYWORDS Education; innovation; curriculum

jebersole@mgh.harvard.edu

33. Characterization of marijuana-related exposures and outcomes reported to a regional poison center from 2010 to 2021

Kristie Edelen, Eszter Moore, Scott Schaeffer and William Banner

Oklahoma Center for Poison and Drug Information, Oklahoma City, OK, USA

Background: With many states decriminalizing marijuana, misadventures and adverse effects are becoming commonplace. Marijuana is formulated into many products including gummies, brownies, cookies and chips, which are attractive to children. In some cases a small bag of chips can contain up to 600 mg of tetrahydrocannabinol (THC) or more. Unintentional pediatric cannabis exposures are associated with clinically significant effects, including respiratory depression, hypotension, and bradycardia. The primary objective of this study was to describe the increase in marijuana exposures reported to a regional poison center (RPC) after marijuana use was decriminalized in 2018. The secondary objective was to characterize marijuana-related medical outcomes to evaluate if medical outcomes are increasing in severity.
Methods: This was a retrospective database study utilizing Toxicall® and ToxSentry® to evaluate human exposures to "Cannabinoids and Analogs" reported to a RPC from 2010 to 2021. There were no limitations on the data set. We specifically evaluated the medical outcome (mild, moderate, major) for patients within this set of exposures, and we characterized the major clinical effects that were seen in this patient population. Data analyzed included year of call, if an exposure required management at a healthcare facility, medical outcome and the clinical effects observed in patients with major outcomes.
Results: There were a total of 2630 marijuana exposures reported to the RPC from 2010 to 2021. Similar to a previous study, inadvertent pediatric exposures increased after marijuana was decriminalized in the state in 2018. From 2010 to 2017, the RPC received on average 5 calls per year in which a pediatric patient had been exposed to marijuana in comparison to the 211 calls that were received in 2021. Also of concern was the increase in the number of major outcomes that were seen in this patient population. In 2021, 20 patients who had major outcomes related to marijuana exposures were reported to the regional poison center. Due to the RPC changing database software systems in the middle of 2021, only 14 of these cases could be reviewed to determine the clinical effects documented for those patients who had a major outcome. Upon analyzing this data, it was found that patient age ranged from 3 to 51 years of age, with an average age of 22 years of age. The most common adverse effects that were seen among these patients included: CNS depression (major) (71.4%), respiratory depression (50%) and vomiting (42.9%). The number of marijuana-related exposures reported to an RPC has increased seven-fold since 2016. Moderate and major effects requiring medical care have become commonplace, prompting more frequent patient care consults from emergency and critical care providers. Of the cases with major outcomes, CNS depression, respiratory depression, and vomiting were the most common clinical effects.
Conclusions: The RPC has seen a significant increase in marijuana-related exposures over the last 12 years, and there has been an increase in major outcomes from 2010 to 2021. There is a need to raise awareness of the increasing rate of major outcomes of not only pediatric patients, but also in the adult population. Clinicians in states considering decriminalization of marijuana should be proactive in attempting to influence serving size and packaging restrictions to minimize pediatric exposures.

KEYWORDS Marijuana; adverse effects; pediatric

kristie-edelen@ouhsc.edu

34. Association between teen obesity and suicidality: data points from the National Poison Data System (NPDS)

Alfredo Gonzalez[a], Darelle Hinson[a], Darien A. Hinson[b], Shawn Varney[a] and Han Gao[a]

[a]South Texas Poison Center, UT Health-San Antonio, San Antonio, TX, USA; [b]Baylor College of Medicine, Houston, TX, USA

Background: According to the Centers for Disease Control and Prevention (CDC), childhood obesity is defined as a body mass index 95th percentile, and overweight is determined by the 85th percentile. In the US, childhood obesity has quadrupled in adolescents in the past 30 years, with one-third of teens now considered overweight or obese. In addition, teen suicide has increased over the past decade. The CDC recently reported a 43.4% increase in ED visits from 2017 to 2018 for suicidality in patients aged 10–19 years. The reasons are likely multifactorial. Gender dysphoria, systemic racism, bullying, sexual and physical abuse, and weight shaming have all been implicated in the literature. Several studies have confirmed an association between childhood obesity and mental health disorders. We present data from NPDS to determine if there is an association between obesity and suicide attempts in adolescents.
Methods: We conducted a retrospective study using data from Toxicall sourced from the six Poison Centers surveyed from January to December 2021. We compared the reported mean weight of 13–17-year-old boys and girls that attempted or committed suicide. The weight data were compared to the mean national weight of children of the same age and gender using descriptive statistics.
Results: We identified 2695 patients aged 13–17 years of age who reported attempting or committing suicide. Of these, 489 (18.1%) were boys, and 2206 (81.9%) were girls. The mean national weight for 13-year-old (yo) boys was 45.6 kg, while our group's mean weight was 64.9 ($n = 85$). Similarly, the national vs the study sample mean weight for 14 yo boys was 51 kg versus (vs) 69.2 ($n = 78$), respectively; for 15 yo boys, 56.6 kg vs 72 ($n = 115$); for 16 yo boys, 60.9 kg vs 74.7 ($n = 113$); for 17 yo boys, 64.6 kg vs 81.8 ($n = 98$), respectively. The mean national weight for 13 yo girls was 45.8 kg, while our group's mean weight was 63.8 (n-496). Similarly, the national vs the study sample mean weight for 14 yo girls was 49.4 kg vs 75.4 ($n = 78$), respectively; for 15 yo girls, 52 kg vs 59.9 ($n = 554$); for 16 yo girls, 53.9 kg vs 63 ($n = 425$); for 17 yo girls, 55.1 kg vs 69.1 ($n = 281$), respectively.
Conclusions: In our study sample, 13–17-year-old boys and girls who reported suicidal ideations or attempts generally weighed more than similarly aged teenagers nationally.

KEYWORDS Teen obesity; suicidality; overweight teen

gonzaleza1@uthscsa.edu

35. Pregnancy associated adverse events in patients treated with therapies for COVID-19 reported to the FDA ACMT COVID-19 ToxIC (FACT) pharmacovigilance project

Mark Simon[a], Jennie Buchanan[a], Jeffrey Brent[b], Paul Wax[c], Keith Burkhart[d] and Kim Aldy[e]; On behalf of the ToxIC FACT Study Group

[a]Denver Health and Hospital Authority/Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]School of Medicine, University of Colorado, Aurora, CO, USA; [c]University of Texas Southwestern, Paradise Valley, AZ, USA; [d]US Food and Drug Administration, Hershey, PA, USA; [e]American College of Medical Toxicology (ACMT), Phoenix, AZ, USA

Background: The COVID-19 pandemic prompted an unprecedented surge in repurposing and developing available pharmaceuticals and therapies for approved and unapproved prophylaxis or treatment of the SARS-CoV-2 virus. Due to variations in physiology and fetal risk, pregnant patients are often excluded from pharmaceutical efficacy and safety studies. Therefore, this population is vulnerable to adverse events (AEs) from such therapies.
Methods: This is a case series of AEs in pregnant patients associated with therapies for COVID-19 submitted to the FDA ACMT COVID-19 ToxIC (FACT) Pharmacovigilance Project between November 23, 2020 to April 14, 2022. FACT is an active surveillance project with 17 geographically distinct participating medical centers focusing on identifying possible AEs related to any medication or substance administered by a provider or patient with the intent to treat or prevent COVID-19 infection. Cases are identified via site-specific mechanisms, including direct contact, provider self-referral, pharmacist referral, or chart review. The inclusion criteria in this subset analysis included pregnant patients with suspected AEs after a COVID-19 therapy.
Results: Of the 263 cases reported to FACT during the study period, 24 (9.1%) of the cases were suspected AEs in pregnant patients. The majority of these AEs were in patients exposed to monoclonal antibody (mAb) treatments for COVID-19. Black/African patients comprised 9 (38%) of cases of AEs. One case was of a patient who developed hepatotoxicity from supratherapeutic acetaminophen use to treat COVID-19 symptoms. The most common effects were gastrointestinal, but patients developed a wide range of AEs. In 14 cases, the provider filled out the FACT Pharmacovigilance Projects' Pregnancy and Fetal Supplemental Data Collection Form, which provided further details specific to the patient's obstetric history. This dataset revealed six patients who required emergency cesarean sections, five of which were due to fetal distress and one for maternal factors. Overall, while there were zero deaths, there were multiple cases deemed to have life-threatening reactions, requiring intervention, or necessitating a higher level of care.
Conclusions: The FACT Pharmacovigilance Project was created as a novel multi-site pharmacosurveillance program to monitor real-world AEs related to therapies utilized for the prophylaxis and treatment of COVID-19. Pregnant patients represent a high-risk group often excluded from medical trials. This data displays AEs which occurred in response to COVID-19 therapies. Further study and analysis will be needed to evaluate the effects of these therapies on the development of fetal distress and congenital anomalies. This project is ongoing and will continue to identify ADEs associated with COVID-19-related therapeutics. Source of funding This project was funded by the US Food and Drug Administration (FDA) under Task Order Contract #75F40119D10031.

KEYWORDS Adverse event; pregnancy; COVID-19

mark.simon@denverem.org

36. Adding insult to injury: deaths attributed to lead toxicity from retained bullet fragments

Emily Kershner, Natasha Tobarran, Andrew Chambers, Brandon Wills and Kirk Cumpston

VCU Health, Richmond, VA, USA

Background: Due to significant public health measures and lead screening programs, fatalities associated with lead poisoning are now rare. Significant lead exposures are typically due to lead-based paint or herbal products. Lead toxicity secondary to retained bullet(s) (RB) after a penetrating gunshot wound is a rare but likely underdiagnosed condition, given the substantial number of firearm injuries in the US. Little is known about the clinical course of lead toxicity in this patient population or associated mortality. The primary aim of this series was to describe cases in the literature of fatal lead toxicity due to RBs.
Methods: The primary literature search was conducted in Medline (PubMed), EMBASE, Cochrane, and CENTRAL using the following MESH terms: "chelation" and "lead poisoning" or "lead toxicity" or "lead" and "bullet" or "missile" or "gunshot," or "bullet." Cases that described a fatality secondary to a retained bullet were included in the study. We excluded papers if they were duplicates, animal studies, had no history of an RB, oral ingestion of bullets or other etiologies for lead toxicity, absence of documented lead concentration, or there were no symptoms of lead toxicity. Identified cases were then summarized. Data collected included demographic information, location of RB, reported symptoms, timing of symptom onset, blood lead levels (BLL), time to death, chelation treatments, and autopsy findings.
Results: The search identified 1082 articles. After exclusions, a total of four patients from four articles were included in our descriptive analysis. All cases were female with a median age of 53 years. Two of the fatalities were associated with RBs located in a knee joint and two were located in the peritoneal space and pelvis. There was one case in which only a urine lead level was taken antemortem, but an autopsy demonstrated heart and liver levels of 0.77 mg/100 g and 7.715 mg lead/100 g respectively. In this case, the symptom onset was 27 years after the initial penetrating injury. For the cases with a reported BLL, the median time to lead toxicity symptom onset from time of penetrating injury was 3 months (1.8, 5) and death within 217 days (161, 230) of symptom onset. All patients had significant signs of toxicity including abdominal pain, encephalopathy, and seizures. The median peak venous BLL was 169 mcg/dL (167, 340). Chelation was performed in two cases with dimercaprol (BAL) and calcium sodium EDTA. All patients had autopsies performed. In one patient, lead toxicity was not considered prior to discovery of BLL of 530 mcg/dL on post-mortem analysis. Antemortem BLL in that case was 510 mcg/dL. Three patients had autopsy findings of lead encephalitis.
Conclusions: In all fatality cases, RBs were located in joints or body cavities and in contact with a bodily fluid. Clinicians should be aware that RBs can lead to significant toxicity and death within months of initial injury. However, death associated with lead toxicity in this patient population is very rare.

KEYWORDS Lead toxicity; retained bullet; death

Emily.Kershner@vcuhealth.org

37. Carburetor cleaner abuse treated at emergency departments

Salvador Baeza[a] and Mathias Forrester[b]

[a]West Texas Regional Poison Center, El Paso, TX, USA;
[b]Independent Researcher, Austin, TX, USA

Background: Carburetor cleaner or degreaser products usually contain methanol and hydrocarbons such as toluene, propane, and isobutene. Persons may inhale carburetor cleaner in order to produce euphoria, hallucinations, central nervous system depression, and other intoxicating effects. However, carburetor cleaner exposure may result in such adverse effects as neurotoxicity (e.g., lethargy, ataxia, coma), vomiting, metabolic acidosis, blindness, and death. The objective of this study was to describe carburetor cleaner abuse managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify carburetor cleaner abuse reported during 2000–2020, records with the letter combinations "carb" along with "clean," "fluid," or "gre" in the record narrative were reviewed, and those that appeared to be cases of carburetor cleaner abuse were included in the study. The distribution of carburetor cleaner abuse cases was determined for various factors. Due to the small number of cases, national estimates were not calculated.
Results: A total of 29 carburetor cleaner abuse cases were identified: 21 (72.4%) during 2000–2006, 4 (13.8%) during 2007–2013, and 4 (13.8%) during 2014–2020. The patient age distribution was 11 (37.9%) 13–19 years, 5 (17.2%) 20–29 years, 9 (31.0%) 30–39 years, 1 (3.4%) 40–49 years, and 3 (10.3%) 50–59 years; the mean age was 27 years (range 13–52 years). Twenty (69.0%) of the patients were male and 9 (31.0%) female. The patient race was 3 (10.3%) white, 2 (6.9%) black/African American, 9 (31.0%) other, and 15 (51.7%) not stated. All of the exposures occurred by inhalation. The location of the incident was 4 (13.8%) home, 3 (10.3%) street or highway, 2 (6.9%) other public property, and 20 (69.0%) not recorded. Clinical effects reported in three cases each were hallucinations; in two cases each were anoxia, chest pain, fever, headache, and vomiting; and in one case each was altered mental status, diarrhea, lethargy, nausea, pharyngitis, psychosis, respiratory distress, tachycardia, throat irritation, and tinnitus. The patient disposition was 21 (72.4%) treated or examined and released, 6 (20.7%) treated and admitted for hospitalization, 1 (3.4%) treated and transferred to another hospital, and 1 (3.4%) held for observation.
Conclusion: Carburetor cleaner abuse treated in EDs declined during the study period. The highest proportion of patients were age 13–19 years, and the majority of patients were male. Most patients were treated or evaluated and released from the ED.

KEYWORDS Carburetor cleaner; abuse; emergency department

sbaeza@umcelpaso.org

38. IV acetaminophen overdose: cases in the American Association of Poison Control Centers' National Poison Data System, 2017–2021

Maryann Hofman, Anthony Jaworski, Jeanette Trella and Kevin Osterhoudt

The Poison Control Center at Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background: An intravenous (IV) form of acetaminophen (APAP) was approved by the US FDA in 2010 with indications for fever reduction and analgesia; it is typically used when oral or rectal routes may be inappropriate such as with operative and post-operative patients. Therapeutic errors have resulted in overdose or prolonged repetitive therapeutic dosing, and at least 10 relevant case reports have been published (6/10 associated with rise in serum AST >1000 U/L). Clinical risk stratification of IV APAP overdose is unclear, and the IBM Micromedex POISINDEX® database (accessed April 14, 2022) offers disparate guidance from TOXBASE®. To assist in making clinical decisions additional data may be beneficial, so we reviewed cases concerning IV APAP as reported to the American Association of Poison Control Centers' (AAPCC) National Poison Data System (NPDS).
Methods: Retrospective review of the AAPCC's NPDS involving all human cases of IV APAP due to therapeutic error reported from 2017 through 2021. Cases included exposures coded with the reason [unintentional- therapeutic error] involving at least one of the generic codes for APAP ["acetaminophen alone, adult" 072705, "acetaminophen alone, pediatric" 072707, "acetaminophen alone, unknown if adult or pediatric" 072000] and the parenteral route of exposure. Descriptive statistics were utilized to show the distribution of baseline demographics. Incidence rates of clinical effects and therapies given were determined.
Results: During the 5-year study period, 193 cases coded as concerning therapeutic error with IV APAP were reported to US poison centers; 124 cases involved only the IV APAP route and 69 cases involved the combination of the IV plus either oral or rectal routes. 41% of cases involved children <6 years, 14% – 6–12 years, 5% – 13–19 years, and 39% occurred among adults aged >19 years; 53% of cases were male. Antidotal treatment with n-acetylcysteine was reportedly given in 19% of cases. No deaths were attributed to IV APAP, but per NPDS conventions 6% were noted to have minor, 8% moderate and 2% major clinical effects. A serum AST concentration >100 U/L was documented in 5% of cases (exceeding 1000 U/L in 2%). All of the cases with hepatotoxicity occurred among the group with combined IV plus oral/rectal administration.
Conclusions: In 2010, U.K. drug regulatory agencies reported analyses of 23 cases of IV APAP overdose among children aged <1 year, with one death involving an infant receiving a 10-fold overdose; and analysis of another 206 cases of which 44 occurred in neonates (2 classified as severe). In addition to individual published case reports, during the years 2017–2021 the NPDS adds documentation of an additional 193 cases. Within the NPDS database, nearly 1 in 5 IV APAP cases was treated with n-acetylcysteine, and 16% were noted to have experienced adverse clinical effects. So far, discrete variables from the NPDS aggregate have been analyzed; review of individual records with narrative fields will allow quantification of potential miscoding within the database, and will allow closer assessment of potential IV APAP-associated hepatotoxicity. Further analysis of IV APAP overdose cases

may allow for development of uniform risk stratification and treatment guidelines; system improvements to prevent IV APAP overdose events remain an important goal.

KEYWORDS Acetaminophen; therapeutic error; poison control centers

hofman@chop.edu

39. An 8-year-old female with crotalid envenomation and marked myokymia responsive to crotalidae immune F(ab')$_2$ antivenom

Nate Friedman[a], Justin Seltzer[a], Garret Winkler[a], Daniel Ichwan[b], David Gutglass[b] and Allyson Kreshak[a]

[a]University of California – San Diego, San Diego, CA, USA; [b]Rady Children's Hospital, San Diego, CA, USA

Background: The *Crotalidae* subfamily of snakes, commonly known as "pit vipers" or "crotalids," cause the majority of venomous snakebites reported annually in the US. Major domestic crotalids include copperheads, cottonmouths, and the numerous species of rattlesnakes. All venomous snakes in the state of California are species or subspecies of rattlesnake. Rattlesnake envenomation produces pain, edema, and ecchymosis as well as systemic effects, such as hematotoxicity (thrombocytopenia, hypofibrinogenemia, and coagulopathy) and neurotoxicity (abnormal movements, paresthesias, or neuromuscular weakness). One prominent neurotoxic finding is myokymia, which is involuntary muscle movement or twitching often distant from the bite site. To limit progression of symptoms, treat local and systemic toxicity, and reduce hospital length of stay, antivenom is commonly administered. There are two available antivenoms available in the US: Crotalidae Immune Polyvalent Fab (FabAV; commercially known as CroFab®) and Crotalidae Immune F(ab')$_2$ (Fab$_2$AV; commercially known as ANAVIP®). Both antivenoms are considered safe and effective treatments for rattlesnake envenomations, with well-demonstrated efficacy against progression of local tissue damage and hemotoxicity. However, the data on the efficacy of either antivenom for neurotoxic symptoms is limited. Case reports have been mixed regarding the ability of FabAV to reverse neurotoxicity. To our knowledge, there are no reports of the effects of Fab$_2$AV on neurotoxicity. Here, we report a case of a pediatric envenomation with facial myokymia that improved following administration of Fab$_2$AV.
Case report: A previously healthy 8-year-old female presented to our pediatric emergency department approximately 2 h after she was bitten on the left medial ankle by a self-reported "greenish-brown" snake. She had minimal pain, minimal edema, and no erythema at the bite site. She had myokymia involving the oral, lingual, eye, and facial musculature, causing slurred speech, drooling, and problems cooperating with a cranial nerve exam. We strongly suspected rattlesnake envenomation and administered 10 vials of Fab$_2$AV infused intravenously over 1 h. Approximately 30 min after completion of the infusion, her neurologic symptoms had nearly resolved, with only mild perioral fasciculations remaining. Five hours later, she developed a recurrence of facial myokymia and was treated with an additional 4 vials of Fab$_2$AV, again leading to improvement. She was re-evaluated 12 h later and found to have subtle perioral myokymia with an otherwise normal cranial nerve exam and fluid speech. Serial exams of her leg demonstrated stable trace edema, no erythema, and adequately controlled pain with limb elevation and oral acetaminophen. Serial measurements of platelets and fibrinogen remained within normal limits. She was discharged from the hospital the following day in good condition with mild, intermittent perioral fasciculations but no other deficits or complications.
Discussion: Neurotoxicity is a rare but important complication of crotalid envenomation. Our patient's myokymia demonstrated a dose-response relationship with Fab$_2$AV. Further investigation is necessary to determine the potential of Fab$_2$AV to reverse rattlesnake venom-induced neurotoxicity.

KEYWORDS Crotalid; rattlesnake envenomation; myokymia

nafriedm@gmail.com

40. Evaluating the poison prevention and medicine safety program for English as a Second Language (ESL) instructors and students

Lauren Schwartz[a], Dilem Valenzuela[a], Maria Mercurio-Zappala[a], Mary Ann Howland[b] and Mark Su[c]

[a]NYC Poison Control Center, New York, NY, USA; [b]St. John's University College of Pharmacy, Queens, NY, USA; [c]NYC Department of Health and Mental Hygiene, New York, NY, USA

Background: English as a Second Language (ESL) classes provide an ideal environment to provide health education and collaboration. The PCC developed a Poison Prevention and Medicine Safety Program for ESL Instructors and Students. Each lesson promotes skills-based learning along with literacy development based on goals and measurable objectives. The lessons incorporated PCC-related vocabulary words, role playing (calling the PCC, asking questions about medicines), word development activities, and using PCC materials. Discussion sections provided an opportunity for the students to familiarize themselves with the PCC materials and content. Guided comprehension questions and answers illustrated the teaching material and objectives for the lesson. Although initially in-person, due to the COVID-19 outbreak, ESL classes were moved to remote formats. As a result, the PCC ESL Program was also formatted in an electronic version. Our goals were to learn how the program was utilized, the comfort of the participants with the material, and the perceived interest and comfort of participants with the curriculum.
Methods: One-hour webinar training sessions for ESL instructors were offered to present the program components. ESL instructors throughout the PCC catchment area were invited to participate via email. After the training session, each participant was emailed the electronic version of the program and instructor's guide to use for teaching online classes. Participants were able to request the manual if needed for in-person teaching. Follow-up surveys were sent via email 1 month after each training using Survey Gizmo. The participants were asked to rate program content, PCC materials, and student reactions to the topics. Three email attempts were made to complete the follow-up survey.
Results: Between September 2021 and January 2022, 10 training sessions were provided to a total of 154 participants. Follow-up surveys were collected from training participants in October 2020, January, June, and November 2021, and February 2022. A total of 61 participants completed 80 follow-up surveys (12 participants completed more than one survey). Of the 61 participants, 29 surveys (completed by 20 participants) reported using the PCC ESL program. Most (26; 90%) used the content online, two in person and one used it with another lesson. The activity sheets used most often were role playing activities: Calling the PCC (21/22; 95%) and Asking Questions about Medicines (14/22; 64%). Most responses rated the brochures (16/29; 55%), fact sheets (17/29; 59%) and instructor's guide (20/29; 69%) as "very helpful." All responses (23/23; 100% indicated they were

"comfortable" or "very comfortable" presenting the material. Participants that felt most of students they taught would be either "extremely" or "somewhat comfortable" (22/29; 76%) calling the PCC after the lessons. It was also reported that students were more interested in the topic of medicine safety (23/29; 79%) compared to poison prevention (18/26; 69%). All responses (29; 100%) indicated they would recommend the PCC program to other ESL instructors.
Conclusions: Offering a PCC ESL program focusing on poison prevention and medicine safety combines authentic learning with health information. Follow-up surveys showed that participants were comfortable presenting the content and would recommend the program. Future steps include an evaluation of the training once classes are fully back to in-person.

KEYWORDS Poison prevention; education; ESL students

lschwar1@health.nyc.gov

41. ADvanced Virtual Support for OpeRational Forces (ADVISOR) toxicology cases: a retrospective review of military related cases managed with expert toxicology consultation

Patrick Ng[a] and Joseph Maddry[b]

[a]En Route Care Research Center, San Antonio, TX, USA; [b]Institute for Surgical Research, San Antonio, TX, USA

Background: Military medicine is unique in that operations and medical care can be conducted in austere, resource limited environments. Despite these challenges, being able to continue to operate and care for military members at home and abroad remains essential to ensure mission success. Access to expert consultation is an important aspect of medical care and at times can be limited in the operational setting. To mitigate this potential shortfall, the Military Health System developed and fielded the Advanced Virtual Support for Operational Forces (ADVISOR) program in June 2017. ADVISOR has over 125 volunteer providers across all services that commit to helping service members with real-time telemedicine around the globe. Communication between the consulting medical service member and the consultant is conducted using a smart phone software application. Following the communication, the ADVISOR program personnel email an electronic medical record to the consultant for them to complete and return. The specialty of Toxicology is one of the services accessible through ADVISOR. Since the inception of the program, the Toxicology service has received 27 calls. We report on the calls received through the ADVISOR line that were managed by the Toxicology subspecialty over the past 24 months.
Methods: The (ADVISOR) program keeps an internal log of Operational Virtual Health Reports submitted by specialties consulted. We performed a quality improvement, internal retrospective review of the OVHRs submitted and classified under Toxicology subspecialty between December 2020 to April 2022. Results A total of 5 OVHRs were submitted and available for review. Case 1: Young male overdosed on 750 mg of diphenhydramine and presented with mild agitation and tachycardia. Unknown follow up. Case 2: 33 yo M, in sea water and felt sharp pain to his left foot, after sustaining a puncture to the left foot. Hot water submersion, wound care. Unknown follow up. Case 3: 22 yo M, hydrogen peroxide ingestion, 2 days prior to call. Unknown follow up. Case 4: Training exercise of simulated patient with retained bullet and concerns for lead toxicity. Case 5: 27 yo M, altered mental status after smoking hookah. Unknown follow up. Cases 1, 2, 3, 5 the callers were from international areas with ongoing military operations. There were no telecommunication limitations documented for any of the calls. Treatment recommendations were documented to have been communicated to the medical teams using the ADVISOR line.
Conclusions: The ADVISOR line was used in real world operational scenarios for the management of patients with a reported toxicological exposure. Data captured from the cases were limited. Fellowship trained toxicologists were available for consultation using the ADVISOR line.

KEYWORDS Telehealth; military toxicology; military medicine

patrickcng1@gmail.com

42. Rodenticide ingestions by dogs reported to poison centers

Jeanie E. Shawhart[a] and Mathias Forrester[b]

[a]Texas Tech University Health Sciences Center Jerry H. Hodge School of Pharmacy, Amarillo, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Although intended for rats and mice, other animals, such as dogs, might ingest rodenticides. Depending on the type of rodenticide, symptoms reported with rodenticide ingestion by dogs include vomiting, lethargy, poor appetite, bleeding, tremors, seizures, ataxia, paralysis, and death. The objective of this study was to characterize rodenticide ingestions by dogs reported to poison centers that primarily manage human exposures.
Methods: Cases were rodenticide exposures (Generic codes 0012563, 0043000, 0048563, 0048564, 0077563, 0077577, 0162000, 0174000, 0197000, 0201050, 0201051, 0201052, 0244577) reported to a large, statewide poison center network during 2000–2020 where the exposure route was ingestion, the patient species was animal, and the animal type was dog. The distribution of cases was determined for various factors.
Results: A total of 8817 rodenticide ingestions by dogs were identified. The type of rodenticide was 5615 (63.7%) long-acting anticoagulant, 1027 (11.6%) bromethalin, 254 (2.9%) warfarin-type, 87 (1.0%) zinc phosphide, 72 (0.8%) cholecalciferol, 30 (0.3%) strychnine, 5 (0.1%) n-3-pyridylmethyl-n1-p-nitrophenyl urea, 2 (0.0%) 1-naphthalenylthiourea, 1 (0.0%) barium carbonate, 1 (0.0%) sodium monofluoroacetate, 165 (1.9%) other, and 1558 (17.7%) unknown rodenticide. There were 2445 (27.8%) ingestions during December-February, 2009 (22.8%) during March-May, 1904 (21.6%) during June-August, and 2448 (27.8%) during September-November. The ingestion occurred at the home of the dog's owner or caregiver in 6524 (74.1%) cases, 158 (1.8%) at another residence, 18 (0.2%) public area, 20 (0.2%) other sites, and 2086 (23.7%) at an unknown location. The management site was 4571 (51.9%) on site (outside of a healthcare facility), 4065 (46.2%) at a healthcare facility or other location (probably a veterinarian facility), and 170 (1.9%) at an unknown location. The most commonly reported clinical effects were vomiting ($n = 305$, 3.5%), drowsiness/lethargy ($n = 134$, 1.5%), bleeding ($n = 50$, 0.6%), diarrhea ($n = 47$, 0.5%), anorexia ($n = 42$, 0.5%), hematemesis ($n = 31$, 0.4%), and nausea (30, 0.3%). The ingestion was not serious (no effect, minor effect, moderate effect, not followed-judged nontoxic, not followed-minimal effects possible) in 4969 (56.4%) cases, serious (moderate effect, major effect, unable to follow-potentially toxic, death) in 3796 (43.0%), and unrelated to the ingestion in 41 (0.5%); 10 (0.1%) deaths were reported, but the poison center network generally does not follow animal exposures to determine final outcome.
Conclusions: These cases suggest that rodenticide ingestions by dogs most often occur at the owner's own home. Although a

greater proportion of cases did not result in serious outcomes, a significant number did have serious effects.

KEYWORDS Dog; rodenticide; poison center

jeanie.jaramillo@ttuhsc.edu

43. Carbon monoxide exposures in public indoor ice arenas as reported to Pennsylvania and Delaware poison control centers, 2012–2021

Melissa Zhou[a], John Butterworth[a], Erin Tully[a], Joan Nolan[b], Amanda Korenoski[c] and Kevin Osterhoudt[b]

[a]Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [b]Poison Control Center at Children's Hospital of Philadelphia, Philadelphia, PA, USA; [c]Pittsburgh Poison Center, Pittsburgh, PA, USA

Background: Carbon monoxide (CO) poisoning is a public health concern resulting in >50,000 US emergency department (ED) visits yearly. Most cases arise from house fires, furnace dysfunction, or under-ventilated home use of gas engines such as electrical generators; risks in ice arenas may be under-appreciated as monitoring of CO emissions from gasoline or propane powered ice-resurfacing equipment is not federally regulated. Three states, Minnesota, Massachusetts, and Rhode Island, have implemented state-wide policies that define air sampling, record-keeping, and corrective measure requirements that must be taken by these facilities. To advocate for regional CO-related injury prevention, we sought to define the epidemiology of CO poisoning at indoor ice arenas, as reported to poison centers (PCCs) from Pennsylvania (PA) and Delaware (DE) over 10 years.
Methods: This is a retrospective, descriptive cohort study. Cases concerned with CO poisoning in public spaces (AAPCC generic code 0106000; exposure site = "public area") reported to PCCs in PA and DE from January 1, 2012, to December 31, 2021 were retrieved. Two investigators redundantly reviewed narrative notes and selected cases occurring in ice arenas for inclusion. Discrete data fields from case records were tabulated and two reviewers abstracted narrative notes using standardized data fields. The demographic and clinical characteristics, treatments, and outcomes were summarized using descriptive statistics.
Results: 169 records were initially retrieved, 34 were identified to have occurred in ice arenas, and 5 were found to be duplicative cases. Twenty-nine subjects (PA – 27, DE – 2) from 7 distinct CO exposure events were eligible for study. The ages ranged from 20 months to 54 years [median 13 years; IQR 10–17 years] with 24 (83%) cases <19-years; all events happened in the fall or winter and 27/29 exposures happened between Friday and Sunday. 20/29 (69%) were male, and 19 (66%) were described as hockey players. Between 1 and 9 individual cases were reported per exposure event. Twenty subjects with recorded carboxyhemoglobin (COHb) levels had maximum values from 3.2% to 19.0% [median 12.3%, IQR 7.2–15.4%], although only 16 presented <12 h after exposure. The most commonly reported symptoms were headache (69%), nausea (48%) and dizziness (28%). It was noteworthy that 17% of subjects reported both peripheral neuropathic symptoms and musculoskeletal pain. Additional reported symptoms included fainting (7%), shortness of breath (7%), fatigue (3%), abdominal pain (3%), and chest pain (3%). Twenty (69%) cases were evaluated in an emergency department (ED) with one hospitalized. Nineteen (66%) were treated with supplemental oxygen and one received hyperbaric oxygen; no deaths were reported.
Conclusionss: Enclosed ice arenas are potential sites for mass human CO exposures. Most cases reported from PA or DE to their designated PCCs were symptomatic and received supplemental oxygen during ED evaluation, with the majority of cases among pediatric age groups. This data underestimates actual exposure burden due to under-recognition and voluntary reporting; some exposed individuals from captured events were known to have utilized other state PCCs. One in six subjects in this cohort reported atypical symptoms suggesting peripheral neuropathy. Epidemiological description of CO exposures within ice arenas will inform public health advocacy and policy with a goal toward prevention.

KEYWORDS Carbon monoxide; ice arena; epidemiology

zhoums@chop.edu

44. Corrosive sublimate cigarette: a novel route of mercuric chloride exposure

Grant Comstock[a], Eytan Shtull-Leber[b], Briana Staubo[c], George Sam Wang[d] and Michael Kosnett[d]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]School of Medicine at Colorado State University, University of Colorado, Fort Collins, CO, USA; [c]UCHealth, Fort Collins, CO, USA; [d]University of Colorado Anschutz Medical Campus, Aurora, CO, USA

Background: Acute symptomatic exposure to mercuric chloride (HgCl2) has most commonly occurred by ingestion, often resulting in severe hemorrhagic gastroenteritis and acute tubular necrosis. We present a novel route of exposure via pyrolysis of a HgCl2-containing cigarette.
Case report: A 44-year-old male with history of seizure disorder, anxiety, depression, and opioid use disorder presented to the emergency department (ED) after inhaling 99.5% $HgCl_2$ in a lit hand-rolled cigarette in a suicide attempt. He reported taking the powder from work, and smoking "less than a teaspoon" within 1 h of arrival. He immediately developed palpitations, chest pain, diaphoresis, and non-bloody emesis, which rapidly resolved. He presented awake and alert, with a blood pressure of 173/99 mmHg, heart rate 90/min, respiratory rate 24/min, temperature 36.7 °C, and oxygen saturation 95% on room air. He had a normal physical exam, and laboratory workup was notable only for a urine drug screen positive for methamphetamine and opiates. Electrocardiogram and chest radiograph were normal. Blood and spot urine Hg concentrations were collected on presentation and resulted after discharge at 85 μg/L and >80 μg/L respectively. The patient was given 1 L bolus lactated ringers in the ED and administered two doses of dimercaprol 5mg/kg intramuscular approximately 9.5 and 18.5 h after the HgCl2 exposure. Dimercaprol was chosen for chelation due to unavailability of succimer and unithiol (DMPS). His creatinine remained normal, and he did not develop respiratory, GI, or neurological symptoms. He refused additional treatment with dimercaprol and was discharged home on hospital day 3. Creatinine remained at baseline on return to ED for an unrelated complaint approximately 2 months post-exposure.
Discussion: Acute inhalational Hg toxicity is most often reported in the setting of accidental exposure to high doses of elemental Hg vapor and may result in severe pneumonitis as well as neurological injury. Inhalational exposure to HgCl2 is rare and poorly characterized. Pulmonary HgCl2 absorption is undefined in humans but estimated approximately 40% in dogs. A previous case report of a patient who unknowingly insufflated approximately 4 g $HgCl_2$ instead of cocaine developed severe local irritation with subsequent acute kidney injury, briefly requiring hemodialysis. He had a peak urine Hg concentration of 1989 μg/L and was chelated with DMPS and D-penicillamine with full

recovery. In cases of acute HgCl2 ingestion, overt nephrotoxicity has occurred at blood Hg concentrations >500 μg/L and often greatly exceed 1000 μg/L. Given the paucity of experience with HgCl2 inhalational exposure but theoretical potential to achieve high concentration with end organ toxicity, we chose to initiate chelation prior to confirmatory Hg concentrations. His pulmonary and renal functions were at baseline 2 months post-exposure. This patient's peak blood concentration of 85 μg/L suggests either he did not sustain an overtly nephrotoxic dose or the therapeutic benefit of prompt use of dimercaprol.
Conclusions: We present a case of inhalation of a $HgCl_2$ cigarette, a novel route of exposure. We demonstrate that a Hg salt can be acutely absorbed via inhalation, though short-term toxicity may be limited depending on the dose and prompt chelation.

KEYWORDS Mercury; chelation; metals

grantcomstock@gmail.com

45. Cardiovascular collapse and prolonged EKG changes in an adolescent with mixed nortriptyline/nadolol overdose

Hannah Spungen[a], Jacqueline Kurth[b], Leanne Cook[a] and Michael Levine[a]

[a]UCLA Department of Emergency Medicine, Los Angeles, CA, USA; [b]St. Mary Medical Center-Long Beach, Long Beach, CA, USA

Background: Tricyclic antidepressants (TCAs) are associated with high morbidity and mortality in overdose primarily due to sodium channel blockade-mediated central nervous system depression, dysrhythmias, and refractory hypotension. This refractory hypotension may be exacerbated by cardioactive coingestions such as beta blockers. The mainstay of management for TCA overdose is aggressive supportive care; however, in cases refractory to maximal medical therapy, extracorporeal membrane oxygenation (ECMO) is sometimes used as a bridge to cardiac recovery.
Case report: A 17-year-old female was found altered following a possible nortriptyline overdose. Upon EMS arrival, her blood pressure was 79/56 and heart rate was 72. Her initial GCS was 11. Shortly after arriving to the Emergency Department, she began to seize and then sustained cardiac arrest. She was intubated and received continuous epinephrine, norepinephrine, vasopressin, 3% saline, and two doses of intralipid (20%, 100 mL each). Return of spontaneous circulation was transiently achieved, but she had two additional cardiac arrests and was ultimately placed on veno-arterial ECMO. She had serial EKGs that showed both a QRS and QTc of 193 and 551 ms, respectively. She only had a single episode of tachycardia at 113/min. Upon pediatric intensive care unit arrival, the patient was loaded with phenobarbital and a bedside echo showed hypodynamic cardiac function. Due to the lack of tachycardia, a more detailed medication history was obtained from her mother which included the presence of nadolol in the house. The patient was subsequently treated with glucagon in addition to continued phenobarbital, hypertonic saline, sodium bicarbonate, and magnesium. The patient was decannulated on hospital day #3, though she did not return to her neurologic baseline until hospital day #6. Her bicarbonate drip could not be weaned until hospital day #8 due to persistent QRS widening. She was ultimately discharged to an inpatient psychiatric facility, neurologically intact, on hospital day #21. Comprehensive drug testing confirmed the presence of nortriptyline along with salicylate, alpha-hydroxymidazolam, and lorazepam (the latter two of which were presumably iatrogenic). Serum nadolol levels ultimately returned at 1100 ng/mL (reference range 26–191 ng/mL). Pharmacogenomic testing showed that the patient was an intermediate metabolizer at CYP2D6 and CYP2C19.
Discussion: ECMO has not been studied on a large scale in adolescents but was an effective bridge in this case of mixed TCA and beta blocker-induced arrest refractory to multiple vasoactive agents, intralipid, and alkalinization therapy. This patient's initial presentation was not entirely consistent with a pure TCA overdose due to her persistent lack of tachycardia and hypodynamic cardiac function, which offered important clues to the beta blocker coingestion. Her prolonged clinical course was also not typical of most TCA overdoses, prompting the pharmacogenomic panel. TCAs are extensively metabolized by CYP2D6 with some contribution from CYP2C19, and the patient's intermediate metabolizer status for each of these could explain the persistence of her encephalopathy and EKG changes 6 and 8 days respectively after her ingestion.
Conclusions: ECMO may be an appropriate therapy for adolescents with refractory overdose-related cardiac arrest. Pharmacogenomic testing may be of value in patients with unusually prolonged toxidromes.

KEYWORDS Tricyclics; beta-blocker; ECMO

hspungen@gmail.com

46. Case series presentation profile of olanzapine post-injection delirium/sedation syndrome

Jason Seebaluck[a], Jared Brown[b], Katherine Isoardi[c], Ketih Harris[c] and Betty Shuk Chan[a]

[a]Prince of Wales Hospital, Sydney, Australia; [b]New South Wales Poisons Information Centre, Sydney, Australia; [c]Princess Alexandra Hospital, Brisbane, Australia

Background: Olanzapine pamoate is a long acting salt based intramuscular depot injection for the treatment of schizophrenia since 2009. Approximately 1.4% of patients develop a serious adverse event called Post injection delirium/sedation syndrome (PDSS). PDSS is characterised by excessive sedation, anticholinergic symptoms, extrapyramidal symptoms, dysarthria or ataxia. To determine the presentation characteristics and onset time of Olanzapine PDSS to formulate a novel treatment approach.
Methods: This is a retrospective review of patients who had the diagnosis of Olanzapine PDSS from two toxicology units and the New South Wales Poisons Information data between January 2017 and February 2022. Adult patients were included if they had been given intramuscular Olanzapine and developed and fulfilled PDSS criteria. Clinical symptoms, time to symptoms, length of symptomology and treatment were extracted and entered into a preformatted Excel database.
Results: There were 12 patients, with a median age of 45 years (IQR: 33–49) and male predominance (92%). Dose ranged from 210 to 405 mg. Median onset time to PDSS symptoms was 15 min (IQR 10–45), with the most frequent first symptom being drowsiness and confusion. PDSS symptoms predominate with drowsiness, confusion, slurred speech, ataxia and agitation as highlighted by. Median length of symptoms was 25.83 h (IQR: 20–50). In one case, we propose a novel treatment approach with bromocriptine and physostigmine followed by rivastigmine to manage anti-dopaminergic and anticholinergic symptoms respectively, which may provide substantial opportunity to lessen or shorten symptoms.
Conclusions: This case series supports Detke et al 2010 characterisations of PDSS symptomology predominantly being those of anticholinergic syndrome with similar onset (<1 h) and duration

times (<72 h). A novel treatment is proposed for the management of PDSS.

KEYWORDS Olanzapine Post-Injection Delirium/Sedation Syndrome; anticholinergic; dopamine antagonist

Jason.seebaluck@health.nsw.gov.au

47. Fomepizole – huh, yeah, what is it used for: an analysis of US poison center data on fomepizole use over 12 years

Kennedy Erickson[a], James Leonard[b], Faisal Minhaj[c] and Joshua King[d]

[a]Washing State University College of Pharmacy and Pharmaceutical Sciences, Spokane, WA, USA; [b]Maryland Poison Center, Baltimore, MD, USA; [c]Centers for Disease Control and Prevention, Atlanta, GA, USA; [d]Maryland Poison Center, University of Maryland, Baltimore, MD, USA

Background: Fomepizole is an antidote for toxic alcohol (TA) poisoning (i.e., methanol and ethylene glycol) through competitive inhibition of alcohol dehydrogenase. The gold standard for detecting TA is gas chromatography, which is not accessible at most institutions within a reasonable time frame. Clinical presentation and common labs are used to diagnose TA poisoning. Since diagnostic criteria to identify TA poisonings are nonspecific, fomepizole is often administered to patients who have not ingested a TA. The objective of this study is to compare TA and non-TA exposures where fomepizole was administered.
Methods: This is a retrospective evaluation of the National Poison Data System from January 2010 to December 2021. Cases were included if fomepizole was coded as "performed" or "recommended and performed." TA cases were defined if either ethylene glycol or methanol was a coded substance. For non-TA cases, the first substance was described unless ethanol was co-ingested. In these situations, the exposure was considered ethanol. We examined reason for exposure, demographics, outcomes, level of care, co-ingested ethanol, and key clinical effects and interventions between the TA and non-TA groups. Continuous data were analyzed with *t*-test and categorical data were compared with chi-square test.
Results: 25,110 exposures received fomepizole over 12 years. Use increased from 1955 in 2010 to 2710 in 2021. Most use was for TA (14,636; 58.5%). TA cases were older (43.3 vs 39.8 years; $p < 0.001$) and more likely male (65.7% vs 58.2%). Level of care was mostly a critical care unit (67.7%), but this was less common in TA cases compared with non-TA cases (63.3% vs 74.2%; $p < 0.001$). The initial call was less likely to originate from a healthcare facility in TA vs non-TA exposures (93.3% vs 79.2%; $p < 0.001$). The most common non-TA substances were an unknown drug or chemical (2744; 26.1%), ethanol (2590; 24.9%), acetaminophen (911; 8.8%), unknown non-drug (797; 7.7%), and isopropyl alcohol (755; 7.3%). The co-ingestion of ethanol was more common in non-TA exposures vs TA exposures (37.8% vs 16.1%; $p < 0.0001$). Use in acetaminophen poisoning was stable (~30 cases/year) until 2019; it was used in 461 cases in 2021. Self-harm as the reason for exposure was more common in TA exposures than non-TA exposures (65.9% vs 35.2%; $p < 0.001$). Acidosis was coded in a lower proportion of TA cases than non-TA cases (43.9% vs 65.5%; $p < 0.001$); increased creatinine was also less frequent in TA cases than non-TA cases (21.1% vs 34.8%; $p < 0.001$). Hemodialysis was performed more frequently in TA exposures vs non-TA cases (34.7% vs 19.4%; $p < 0.001$), but continuous renal replacement therapy was less frequent in TA vs non-TA exposures (0.8% vs 3.1%; $p < 0.001$). Bicarbonate was administered less frequently in TA vs non-TA exposures (25.5% vs 33%; $p < 0.001$).
Conclusions: While most use of fomepizole is for a TA, a large minority of cases receive fomepizole for non-TA poisoning. In cases where no TA was coded, the coded substance was primarily unknown in 26% of cases and ethanol made up an additional 25%. Better tools for diagnosis of unknown metabolic acidosis are needed.

KEYWORDS Fomepizole; toxic alcohol; diagnostics

kennedy.erickson@wsu.edu

48. Fentanyl signals in NPDS exposures to opioid and non-opioid products

Daniel Spyker[a], Alvin Bronstein[b] and Julie Weber[c]

[a]Oregon Health and Science University, Camas, WA, USA; [b]Hawaii Department of Health, Honolulu, HI, USA; [c]Missouri Poison Center at SSM Health Cardinal Glennon Children's Hospital, St. Louis, MO, USA

Objectives: The National Institute of Drug Abuse's National Drug Early Warning System (NDEWS), between 2018 and 2021, reported law enforcement counterfeit pill seizure containing illicit fentanyl increased 475 fold (290 thousand to 9.65 million). During 2016–2019, 115,000 overdose deaths were attributed to fentanyl and analogs – provisional data suggest a continued increase. NDEWS data are available quarterly and do not identify specific products. We examined the National Poison Data System (NPDS) human exposure data to support and compliment these NDEWS findings. We expected that increase in the fraction of fentanyl adulterated products would be associated with an increasing morbidity over this period (signal) with or without an increase in reported exposures.
Methods: We examined NPDS closed human exposures monthly from January 1, 2016 to March 31, 2022 for the seven pharmaceutical categories (PCs) with >1000 exposures for benzodiazepines, cocaine, heroin, hydrocodone alone or combinations without ASA or APAP, hydrocodone + APAP, oxycodone alone or combinations without ASA or APAP, and oxycodone + APAP. We calculated linear change over time for all exposures, serious exposures (medical outcome = moderate, major or death), and morbidity index (MI = serious exposures ×1000/total exposures). We carried out a similar examination of the product group (PG) exposures and assessed MI correlation with the NDEWS data by quarter. Data management and statistics used SAS JMP (v 16.0.0).
Results: The seven PCs identified 475,120 exposures involving 17,141 individual products. We mapped these products to 3800 PGs and ranked the PGs with >50 serious exposures/month based on increase in MI over time with $p < 0.05$. This approach identified nine possibly fentanyl adulterated (candidate) PGs and four co-ingestants (ethanol, marijuana, quetiapine and trazodone). The co-ingestant PGs are not among the products in the nine PCs studied so they were frequently taken with 1 or more of the candidate PGs. Marijuana, and quetiapine were least frequently associated with serious exposures, 77 and 92 per month respectively. The top four PGs by MI increase were oxycodone + APAP, heroin, cocaine and alprazolam. Fentanyl was included for comparison and showed no statistically significant MI increase, but the highest MI mean [95% CI] of 702 [678, 726].
Conclusions: NDEWS found alprazolam, hydrocodone and oxycodone as potentially fentanyl adulterated products – our analyses identified fentanyl signal in all three of these products as well as several other candidate products. Oxycodone + APAP showed the highest correlation with NDEWS data and the greatest increase in MI. The identity of candidate PGs depends on the

accuracy of product coding by poison center specialists which we are not able to assess. With or without confirmation of these additional fentanyl adulterated products, the prevalence of these potentially lethal exposures should stimulate poison centers to proactively address this public health issue. The near real-time characteristic of NPDS can be used to study trends detected by other systems like NDEWS. The value of NPDS data to detect emerging trends of contaminated products is attributable to precise and competent data collection by specially trained poison center medical experts. Human interaction, astute clinicians and a near real-time database provide the foundation for detecting and reacting to emerging public health threats.

KEYWORDS Fentanyl adulterant; counterfeit pills; morbidity index

spykerfarm@gmail.com

49. Are poison control center educators incorporating suicide prevention messaging into their outreach? Assessing educators' perceptions and beliefs across poison centers nationwide

Alexa Steverson[a], Tammy Noble[b], Wendy Stephan[c], Britni Overall[d] and Jacqueline Kakos[e]

[a]NC Poison Control, Charlotte, NC, USA; [b]Iowa Poison Control Center, Sioux City, IA, USA; [c]Florida Poison Information Center-Miami, Miami, FL, USA; [d]Georgia Poison Center, Atlanta, GA, USA; [e]New Mexico Poison and Drug Information Center, Albuquerque, NM, USA

Background: According to the Centers for Disease Control and Prevention (CDC), suicide by poisoning is among the 10 leading causes of injury death in the US Studies indicate that suicidal poisonings and self-harm are increasing, especially among younger adolescents. A survey of poison control center (PCC) educators was conducted to discover whether educators are addressing the issue of poisoning suicide and self-harm with the public or with suicide prevention partners.
Methods: The survey was conducted over a 3-week period among educators of the 55 PCCs nationwide. It sought to determine participants' perceptions and beliefs about incorporating suicide prevention education into PCC outreach. The survey also asked about current activities related to suicide prevention. Forty-two respondents completed the survey, a 48% response rate. Respondents were stratified by years of service and by status as a Specialist in Poison Information (SPI) educator or non-SPI educator. Two responses were reclassified as non-SPI responses after further review.
Results: Nearly three-quarters of all respondents (71%) believed that suicide prevention education should be included in PCC education practice, one-quarter of respondents (24%) were unsure, and 5% said it should not be a part of education practice. Nine survey respondents (22%) were SPI educators, and this group was split about incorporating suicide prevention into their practice (44% yes; 56% not sure). Over half of all respondents (51%) already incorporate suicide prevention into their center's outreach. Of the 49% of all respondents who are not conducting suicide prevention education, 85% were unsure if their PCC director would support this work. Although most respondents believed educating about suicidal poisonings is important, only one-quarter (27%) said they have the right knowledge to incorporate this issue into their outreach. In conjunction, 54% of all respondents said they are partnering with community agencies that educate about suicide prevention. Finally, nearly two-thirds of all respondents (63%) said they have been personally touched by self-harm or suicide in some way.
Conclusions: Most respondents believed that suicide and self-harm are topics that should be integrated into PCC education practice. However, educators generally desired more training, as well as guidance from center directors, on how to best incorporate these topics into practice. Though some respondents expressed concerns about working in this area, experts in the field of suicide prevention have developed strategic initiatives that can guide PCC suicide prevention efforts. The CDC's Suicide Prevention Strategic Plan calls upon public health partners to collaborate by sharing data on suicide trends and by taking preventive actions based on evidence. Given PCC work in communities and the proximity to near real-time data, center educators are well placed to contribute to this work. Understanding risk and protective factors for suicidal and self-harm poisonings, incorporating means restriction into education, and determining the demographics and ethnicities most impacted can help PCC educators shape suicide prevention messaging. With niche poisoning data and collaboration among SPIs, educators, and directors, PCCs can add to the body of evidence on what is known about poisoning suicide and self-harm and can build the suicide poison prevention picture.

KEYWORDS Poisoning suicide; suicide prevention; public education

alexa.steverson@ncpoisoncontrol.org

50. Clinical effects of cannabis compared to synthetic cannabinoids (SCs): a retrospective cohort study

Mitchell Waters[a], David Wood[a], Christopher Yates[b], Alison Dines[a], Isabelle Giraudon[c], Matthias Liechti[d], Oscar Miro[e], Odd Martin Vallersnes[f], Fridtjof Heyerdahl[f], Knut Hovda[g] and Paul I. Dargan[h]

[a]Guy's and St Thomas' NHS Foundation Trust, London, England; [b]Palma de Mallorca, Palma, Spain; [c]European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), Son Espases Hospital Universitari, Lisbon, Portugal; [d]University Hospital Basel, Basel, Switzerland; [e]Hospital Clinic de Barcelona, Barcelona, Spain; [f]University of Oslo, Norway; [g]Oslo University Hospital, Oslo, Norway; [h]Clinical Toxicology, London, England

Background: Synthetic cannabinoids (SCs) are new psychoactive substances (NPS) designed to act at endogenous CB1 and CB2 receptors. Over the last 15 years SCs have been increasingly identified amongst NPS throughout the world and over 180 SCs have been identified. Previously a small cohort study suggested greater cardio- and neuro-toxicity in acute SC toxicity compared to cannabis. In this study, a large cohort of patients with self-reported SC or cannabis use has been analysed to compare the clinical toxicity of cannabis and SC to further consider this issue.
Methods: Data were extracted from the Euro-DEN Plus dataset on 54,314 presentations to Emergency Departments in Europe with acute recreational drug toxicity from 2013 to 2020. Presentations which self-reported sole exposure to cannabis or SCs were identified. Univariate analysis of demographic and clinical data were performed using cannabis patients as the control group to determine outcomes from exposure to cannabis versus SCs.
Results: There were 2659 self-reported lone cannabis and 504 self-reported lone SC presentations. These were predominately male in both groups (70.7% cannabis; 88.9% SC), but SC users were more likely to be male ($p < 0.01$). There was no difference in the median (IQR) age in the cannabis (25 (20–33)) or SC (26 (21–35)) presentations. SC presentations were more likely to present via ambulance (85% vs 54%; $p < 0.01$). There were

significantly higher rates of neurotoxicity in SC presentations: they were more likely to be drowsy (49% vs 17%; $p < 0$ .01) or in a coma (3.7% vs 1.9%; $p < 0.01$), agitated (41% vs 22%; $p < 0.01$), to have seizures (8.1% vs 2.6%; $p < 0.01$) and to be psychotic (16% vs 13%; $p = 0.034$). There was no difference in the proportion with arrhythmias between the SC and cannabis presentations (0.8% vs 1.7%; $p = 0.252$), although they had a significantly lower mean heart rate (89 vs 98; p <0.01), systolic blood pressure (122 vs 128; $p < 0.01$) and there were fewer reports of palpitations (5.2% vs 20%; $p < 0.01$) and chest pain (5.2% vs 10%; $p < 0.01$). There was no difference between rates of hyperthermia between groups (SC 0.3% vs cannabis 0.8%; $p = 0.552$). SC patients were more likely to have a psychiatric admission (15% vs 8%; $p < 0.01$), but there was no difference in the proportions admitted to critical care (1.6% vs 1.1%; $p = 0.39$) or in length of stay in hospital (15 h v 17 h; $p = 0.595$).

Conclusions: This retrospective cohort study of over 3000 Euro-DEN Plus patients with either lone cannabis or SC toxicity, has shown that neurotoxicity is more common in those with lone SC compared to lone cannabis toxicity, although some markers of cardiovascular toxicity are less common. Further work is needed to identify whether only certain or all SCs are associated with neurotoxicity, or if the frequency of neurotoxicity has changed over time as the chemistry of the SCs has evolved.

KEYWORDS Cannabis; synthetic cannabinoids; acute toxicity

mitchell.waters@gstt.nhs.uk

51. Accidental carboprost injection in a neonate

Michael Keenan[a], Jeanna Marraffa[b], Joaquim Pinheiro[c] and Molly Boyd-Smith[c]

[a]SUNY Upstate, Syracuse, NY, USA; [b]Upstate NY Poison Center, Upstate Medical University, Syracuse, NY, USA; [c]Albany Medical Center, Albany, NY, USA

Background: Carboprost is a 15-methyl analogue of prostaglandin F2α. It is used to control postpartum hemorrhage when other interventions have failed. Given the high-stress nature of the delivery room, there is a possibility for inadvertent administration of maternal medications to the neonate. We describe a rare case of accidental administration of carboprost to a newborn in the delivery room.

Case report: A 4.15 kg male was born at 39 weeks' gestation by repeat c-section to a multipara woman who had limited prenatal care. The patient was well at birth with Apgar score of 8 at 1 min and 8 at 5 min, with points off for tone and color. Standard postnatal care was initiated. The child received vitamin K IM injection, and then, instead of Hepatitis B vaccine, received 125 mcg Hemabate (carboprost tromethamine) IM. Within 1 h, the patient developed intermittent tachycardia, up to 220s. He was described as "uncomfortable" in appearance. No seizures were reported, but he was noted to have hyperreflexia. He developed hyperthermia to 38.3 °C. The patient demonstrated periods of desaturation down to the 70s%, concurrent with periods of apnea versus periodic breathing. No bronchospasm was noted. The patient was placed on CPAP. The patient was transported to a NICU at a larger center and was transitioned to NIMV. On arrival about 7 h after the exposure, the hyperthermia had resolved. The patient had become hypothermic at 35.2 °C and was actively rewarmed. Vital signs were otherwise unremarkable. He was described as hypotonic and non-vigorous with minimal suck and gag reflexes. Antibiotics were given for possible sepsis. Over the next 26 h, the patient improved, no longer needed NIMV, and was tolerating bottle feeds. The patient was cleared at 48 h, after blood cultures were negative.

Discussion: Inadvertent administration of maternal medications to the newborn in the delivery room are known to occur. However, inadvertent administration of carboprost is rarely documented. To our knowledge, this is the lowest dose documented to cause symptoms, at 30.2 mcg/kg. Prior cases document symptoms at 46.3 mcg/kg and 73.5 mcg/kg. Similar to prior cases, this patient demonstrated hyperthermia and abnormal tone. Hyperthermia is also reported in adults receiving carboprost therapeutically. Also similar to prior cases, the patient developed respiratory perturbations. In this case, these were managed by non-invasive positive pressure ventilation. In a prior case report, the question was raised as to whether the respiratory effect was from the benzyl alcohol diluent. However, there would have been less than 5 mg in this dose, and prior papers suggest the dose needs to be 99–234 mg/kg. Treatment is supportive care. In the cases documented in the literature, recovery occurred in 18–26 h – similar to the case documented here.

Conclusions: Toxicologists should be aware of this potential medication error, and be able to describe potential effects to the primary teams. Management is primarily supportive care. The delivery room remains a target for medication safety interventions.

KEYWORDS Carboprost; medication error; newborn

keenanm@upstate.edu

52. A five-year analysis of the Toxicology Investigators Consortium (ToxIC) core registry: descriptive differences among patients who identified as transgender compared to cisgender, 2017–2021

Kristine Magnusson[a], Derek Fikse[b], Emily Glidden[c], Gillian Beauchamp[b], Kim Aldy[d], Desiree Mustaquim[e], Judith Sabino[b], Marna Greenberg[b] and Alexandra Amaducci[b]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]Strategic Innovative Solutions LLC (SIS), Clearwater, FL, USA; [b]Lehigh Valley Health Network/USF Morsani College of Medicine, Allentown, PA, USA; [c]National Network of Public Health Institutes (NNPHI), New Orleans, LA, USA; [d]American College of Medical Toxicology (ACMT), Phoenix, AZ, USA; [e]National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA, USA

Background: Persons who identify as transgender are at increased risk for a number of negative health outcomes, including substance use and suicide. Healthy People 2030 includes goals for reducing substance use and suicidal thoughts among persons who identify as transgender. We explored medical toxicology consultations from the Toxicology Investigators Consortium (ToxIC) Registry by gender identity (i.e., persons who identify as transgender/gender nonconforming, with a gender identity different than sex assigned at birth, [PWITG], compared to persons who identify as cisgender, with a gender identity matching sex assigned at birth [PWICG]). This data set captures information on hospital patients who had a consult requested by a treating physician for additional patient management related to suspected substance exposures, in many cases presenting with an overdose.

Methods: We conducted a descriptive analysis of consultations involving drug exposures where the patient knowingly ingested

the substance (rather than accidental ingestions) in the ToxIC Registry from 2017 to 2021. Information on demographics, reason for drug exposure, drug class used (e.g., opioids, antidepressants), and clinical presentation was assessed by gender identity. All analyses were performed in SAS 9.4.

Results: A total of 19,606 toxicology consultations were identified; 19,336 identified as cisgender, and 270 identified as transgender. Among cases involving PWITG, 166 (61.5%) were female-to-male, 69 (25.6%) were male-to-female, and 33 (12.2%) were gender nonconforming. The mean age for PWITG was 20 years (median =16) and 31 years (median =26) for PWICG. PWITG had a higher proportion of self-harm (87.8%) as compared to PWICG (63.1%). PWICG reported a higher proportion of misuse of prescription or OTC drugs/illicit substance use than PWITG (6.7%). PWITG had higher proportions of antidepressant exposure (34.1%) compared to PWICG (21.3%), while PWICG had higher proportions of opioid exposures (14.9%) compared to PWITG (4.4%). Other notable differences in drug exposures included higher proportions of analgesic in PWITG (38.9%) compared to PWICG (30.7%) as well as higher proportions of anticholinergic or antihistamine exposure in PWITG (21.5%) compared to PWICG (13.3%). Lower proportions of sedative hypnotic or muscle relaxer exposure were seen in PWITG (8.1%) compared to PWICG (14.5%). PWITG presented proportionally more often with tachycardia (15.6%) compared to PWICG (12.9%). Over half (51.1%) of PWITG, and 60.9% of PWICG presented with a nervous system abnormality, the most common being coma or central nervous system (CNS) depression, where PWITG had a lower proportion (23.7%) compared to PWICG (35.9%).

Conclusions: We identified both similar and different drug consultations among patients who identified as transgender and those who identified as cisgender. Notably, PWITG had a higher proportion of exhibited drug use for self-harm than PWICG. This could be a result of both increased risk for suicide among PWITG generally and increased nonfatal suicide attempt risk among younger as opposed to older age groups. Further research examining drug overdoses among PWITG may help prevent overdose and inform best care practices for this population. Screening for suicide risk and referral to both substance use and mental health services could simultaneously help prevent intentional and unintentional overdose.

KEYWORDS Transgender vs. cisgender; drug exposures; overdose

pwf1@cdc.gov

53. Brain death mimickers: a retrospective review of poisoned patients considered for organ donation

Avery Michienzi, Carlos Cevallos and Nathan Charlton

University of Virginia, Charlottesville, VA, USA

Background: Brain death is the irreversible loss of all brain and brainstem functions, yet the diagnosis of brain death can be complicated by drug overdose. Because symptoms of overdose are reversible, patients who have symptoms that mimic brain death should not be declared brain dead unless the ingested drug is no longer exhibiting effects. Several drugs are known to cause symptoms similar to brain death including alcohol, barbiturates, baclofen, bupropion, antiepileptics, tricyclic antidepressants, organophosphates, zolpidem, and succinylcholine. In this study, we reviewed drugs involved in patients who overdosed and had severe enough illness to trigger consultation of the local organ procurement organization (OPO). The goal was to identify additional drugs that may confound the brain death diagnosis.

Methods: This was a retrospective chart review of patients at a single university hospital who were treated for drug overdose and had symptoms that prompted an OPO consult. Patients were identified using a query of the electronic health record, EPIC. Search terms include patients with an OPO consult in conjunction with an ICD code for drug overdose (ICD 9 690–989 and ICD 10 T36–65). Patients were included if they had a known/suspected toxic ingestion, an OPO consultation, and were intubated during their hospital stay. Patients were excluded if no toxic ingestion was suspect, toxic ingestion was isolated to acetaminophen induced liver failure, they were not intubated during their hospital stay, there was structural brain damage found on imaging, or the patient suffered from cardiac arrest on arrival. The following data were collected from the chart: age, gender, number of days in the hospital, number of days from overdose to OPO consultation, home medications, drugs implicated in overdose, number of days intubated, sedatives and/or opioids used during hospital stay, results from head CT/MRI/brain perfusion scan/EEG if performed. If brain death exam was performed, details were recorded. Ultimate outcome of the patient was also recorded.

Results: A total of 516 patient charts were identified and after charts review 10 patients meet inclusion criteria. The most common reason for exclusion was because no toxic ingestion was suspected upon review of patient chart. Patient age ranged from 23 to 73 years with 5 males and 5 females. No patients underwent official brain death testing. One patient died and did not undergo organ donation. The remaining patients lived with two discharged to psychiatry, six discharged home, and one discharged to prison. Drugs thought to be implicated in overdoses included antiepileptics, opioids, benzodiazepines, sleep aids, antipsychotics, and bupropion.

Conclusions: This study was limited by its retrospective nature and the fact that drugs implicated in overdose were based on information available in the chart. Formal brain death exams were not done in included patients so we are unable to say if symptoms truly mimicked brain death. Many of the drugs noted to cause illness severe enough to trigger OPO consult have previously been noted to mimic brain death. Other drugs identified in this study that may also cause symptoms similar to brain death are benzodiazepines and antipsychotics.

KEYWORDS Brain death; organ donation; overdose

mich0392@gmail.com

54. Case cluster of neurotoxic shellfish poisoning following ingestion of clams collected from the Florida Gulf Coast

Jeremy Lund, Emily Wheeler, Casey Cheney, Tamas Peredy, Brett Williams and Sagar Galwanker

Sarasota Memorial Hospital, Sarasota, FL, USA

Background: Harmful algal blooms (HAB) are an intermittent ecological hazard caused by the overgrowth of dinoflagellates in response to excessive nutrient water contamination. Commonly called "red tide," *Karenia brevis* produces a heat-stable toxin similar in structure and function to ciguatoxin that bioaccumulates in the flesh of filter feeders such as clams, mussels, and oysters. The mechanism of brevetoxin in humans is mediated by augmented influx through sodium channels in nerve and muscle cells. Symptoms from ingestion primarily involve gastrointestinal distress and neurological abnormalities. Harvesting of contaminated shellfish is unusual due to noxious conditions of the water,

respiratory irritation of brevetoxin-laden sea spray, and warning signs posted by the Florida Department of Agriculture. We describe the clinical course of five patients who ingested clams gathered from a local beach.
Case series: Five tourists collected clams from a beach known to be affected by red tide. The clams were soaked in salt water, microwaved for 3 min, and consumed. The index patient experienced seizure-like activity prompting the group to seek medical attention. Each patient reported eating a varying number of clams and presented with a wide variety of symptoms. More severe symptoms were observed in those who ingested a larger number of clams. The index patient (Patient 1) was the most severely affected and experienced diffuse muscle weakness and fasciculations. Two patients (Patients 1 and 2) were noted to have narrow QRS intervals (<80 ms on ECG) without comparison ECGs available. Enhancement of sodium channel flow at cardiac myocytes via brevetoxin could theoretically narrow the QRS complex but is not well studied. None of the patients endorsed cutaneous dysesthesias such as cold-hot sensation reversal. Patient 1 was admitted to the ICU while the other four went to the general medical ward. All five patients were discharged the next day following resolution of their symptoms. Serum and urine samples collected on hospital day 2 from four patients were sent for quantitative brevetoxin assay to the Centers for Disease Control (CDC); results were reported 38 days later. The analytical method used was Brevetoxin in Human Plasma by ELISA. Although no clam flesh was available for analysis, *Karenia brevis* biomonitoring reports from the Florida Fish and Wildlife Conservation Commission indicate markedly elevated levels of *K. brevis* cells (>1,000,000 cells/L seawater) in the waters around the harvest site in the weeks prior to and after the incident.
Discussion: There are few documented cases demonstrating the dose-symptom correlation with brevetoxin ingestion, but this case cluster does show correlation between severity of symptoms and the number of brevetoxin-contaminated clams consumed. Additionally, this cluster also illustrates that consumption of brevetoxin from the same source can cause variable clinical effects. Supportive care is likely adequate therapy. Resolution of symptoms should be expected within 24 h.
Conclusions: Harmful algal blooms continue to pose a threat to human and wildlife. Despite safeguards, human consumption of contaminated shellfish can occur. Care providers must maintain an awareness of the potential hazards caused by local environmental conditions affecting food sources.

KEYWORDS Brevetoxin; shellfish; neurotoxicity

Lund.jeremy@gmail.com

55. Caught red-handed: hydroxychloro-skin

Thom Maciulewicz and Steven Dudley
Arizona Poison and Drug Information Center, Tucson, AZ, USA

Background: Coronavirus disease 2019 (COVID-19) ushered in a plethora of medications to be used off-label by providers and some under the blanket of an FDA issued emergency use authorization (EUA). Hydroxychloroquine (HCQ) gained interest following publication of in vitro data and given EUA status in March 2020 for use with COVID-19. Less than 3 months later the FDA revoked the EUA for HCQ amidst safety and efficacy concerns. Continued use of HCQ by providers for the prophylaxis and/or treatment of COVID-19 increased the prevalence of adverse drug events (ADE). The undesired effects of HCQ can be broken down into consequences of short or long-term use, and into categories of gastrointestinal, dermatologic, cardiac, neurologic, and ophthalmologic toxicities.
Case report: We report a case of a 67-year-old male vaccinated for COVID-19 who was taking HCQ 400 mg daily for the treatment of a mild case of COVID-19 (at home) in addition to his routine daily medications of losartan, levothyroxine, and testosterone. Nine days after initiating therapy with HCQ the patient presented to the emergency department after developing a raised maculopapular rash with blistering originating from his torso and spread to his extremities to include the palms. No complaints of itchiness were endorsed however, he described the presence of generalized burning and pain throughout the areas affected on the skin. Laboratory studies were notable for white blood cell count 30.3 K/μL, neutrophils 78 K/μL, lactate 1.6 mmol/L, all other studies within normal limits. Dexamethasone 4 mg and diphenhydramine 25 mg every 6 h was initiated, and spreading of the drug eruption halted and began receding over the next 3 days of inpatient care. All studies for viral, bacterial, and autoimmune disease resulted negative and the patient was discharged on a steroid taper regimen. Follow up care was arranged for dermatology, home wound care, and monitoring from our poison control center. Over the next couple of weeks, the patient recovered to baseline without complication.
Discussion: During the era of COVID-19, humans worldwide attempted to curb the onslaught of disease with therapies lacking definitive evidence, increased potential for harm and wide array of ADEs. HCQ dermatologic reactions have been commonly reported in women and older adults, and are often mild and self-limiting. Severe drug eruptions can occur but are rare ranging from cutaneous hyperpigmentation to toxic epidermal necrolysis. Management is typically aimed at supportive care using topical or systemic steroids and/or antihistamines. Medical misinformation regarding COVID-19 prophylactic and therapeutic medications on various media platforms have piqued public interest in seeking their off-label use, often unaware of the potential adverse effects or toxicities. Pharmacists serve as a final check of safety and efficacy prior to dispensing, offering counsel on the potential ADEs. However, during COVID-19 many states have pushed legislation bypassing the pharmacists right of refusal to fill and forcing automatic dispensing, thus unnecessarily blunting public safety.
Conclusions: Innumerable ADE have the potential to rear its ugly head especially, in the setting of increased global use. Moreover, pharmacists can be a key resource for counseling on the safety/efficacy regarding therapy to educate patients in the community setting at time of dispensing.

KEYWORDS Hydroxychloroquine; COVID-19; dermatology

tmack3001@yahoo.com

56. Animal exposure calls management by the poison center, data from 2017 to 2021

Reem Alsultan[a], Aditya Gupta[b] and Farshad Mazda Shirazi[a]
[a]Arizona Poison and Drug Information Center, Tucson, AZ, USA; [b]University of Arizona, Tucson, AZ, USA

Background: Animal exposure to toxic substances is considered one of the most common reasons for emergency visits to veterinary care providers. The American Society for the Prevention of Cruelty to Animals (SPCA) provides a poison center service for any animal poison-related emergency, 24 h a day, 365 days a year. In 2021, the Animal Poison Center received over 400,000 cases and found that over-the-counter and prescription medications are among the most common exposures. However, this service may require fees for consultation. Some regional Poison Control Centers (PCCs) can receive calls about potential toxic exposures in animals and help in the guidance and management.

Based on the 2020 annual report of the National Poison Data System (NPDS), 66,754 animal exposure cases were encountered. A study looked at NPDS data for animal exposure calls from 2000 to 2010, and found that 4.7% of all the call exposures were for animal exposure. To describe the characteristics of animal exposure calls that are encountered at our poison control center (PCC).
Methods: We reviewed the data on all the animal exposure calls we received from January 1st, 2017 to December 31st, 2021. Animal exposure calls were characterized by year of exposure, animal species, exposure substance, clinical effect, therapy recommended, and medical outcomes.
Results: From January 1st, 2017 to December 31st, 2021 a total of 6559 animal exposure call cases out of 91,139 (7.2%) of total human and animal calls were received at our PCC. The greatest number of exposure calls occurs in 2018 with 22.4% of all the animal exposure calls over the 4 years period. Dogs and cats account for the highest exposure calls among the animal species with 99.1%. Exposure to prescription medications and ingestion of plants, insects, or food are among the most substance exposure with 28.7% and 18.3%, respectively. Among the therapies that were recommended dilute, irrigate or wash were the highest with 41.6%, followed by observation with 30.4%. For the medical outcomes of animal exposure, minimal clinical effects were the highest outcome with 50.3%, while the outcome of death accounted for 0.06%. The most common clinical effect was GI symptoms with 33.4% followed by cerebellar dysfunction symptoms with 18.8% (including tremor, ataxia, dysphagia, nystagmus, and vertigo).
Conclusions: The poison control centers have an important role in managing animal exposure calls and preventing unwanted emergency visits. An increase in educational resources at PCCs for animal exposure to poisons or bite envenomation is recommended.

KEYWORDS Poisons; prevention

reem.f.alsultan@gmail.com

57. A 7-week-old infant with serotonin syndrome

Deeksha Borkar[a], Andrew W. Kiragu[b], Ann Arens[c] and Abby J. Montague[c]

[a]University of Minnesota, Minneapolis, MN, USA; [b]Hennepin Healthcare, Minneapolis, MN, USA; [c]Minnesota Poison Control System, Minneapolis, MN, USA

Background: Serotonin toxicity manifests with a spectrum of symptoms including neuromuscular excitation in the form of hyperreflexia, muscle rigidity, hyperthermia, agitation and in severe cases seizures and rhabdomyolysis. Physical manifestations of serotonin toxicity are well-described in adults and adolescents. Limited data exist for younger pediatric patients, and the presentation may vary based on stage of neurodevelopment in infants. Our case describes the manifestation of serotonin syndrome in a 7-week-old infant due to citalopram ingestion.
Case report: An otherwise healthy 7-week-old male infant presented to the emergency department (ED) with seizure-like activity witnessed by a parent. Parent described the event as an intense cry followed by extension of both upper extremities with clenching of the fists associated with facial redness that lasted for about 10 min, followed by an episode of eye deviation to the left for 30 seconds. On arrival to the ED, he was afebrile with a heart rate of 144 beats per minute and a respiratory rate of 25 breaths per minute. Episodes of stiff muscle tone and reddening of the skin continued to occur. Initial labs were significant for hyponatremia to 133 mEq/L and a mildly low bicarbonate of 21 mEq/L. Electrolytes and a complete blood count were otherwise unremarkable. Head imaging showed no acute intracranial abnormalities. CRP was undetectable so a lumbar puncture was not done. Due to concerns for seizure-like activity with unclear etiology, he was admitted to the pediatric intensive care unit for video electroencephalogram (vEEG) monitoring. On admission, a urine drug screen was obtained that later returned positive for citalopram on mass spectrometry. Mass spectrometry is routinely done on all urine drug screens at the admitting institution. The results were confirmed with blood testing and repeat urine testing 12 h after admission. The infant was exclusively formula-feeding. While admitted, the patient had intermittent tachycardia, hypertension, and episodes of uncoordinated movements which resolved after a dose of intravenous midazolam (0.1 mg/kg). However, he did not respond to stimuli as expected for age. Toxicology consult exam the day after presentation noted mydriasis, absence of visual tracking, and an overall lack of expected interaction with the environment. Arms and legs were held in flexion at rest and the neck was held in flexion during head lag assessment, indicating increased tone for age. Infant had 7–8 beats of clonus, nystagmus present, and an upgoing Babinski which all can be normal for age. No seizures were detected on vEEG and vital signs stabilized with a return of normal visual tracking over the next day. Tone became normal then low and the patient was referred to occupational therapy upon discharge. During the investigation, it was discovered that a caregiver was crushing citalopram pills and adding them to his formula. At 2 year follow-up, he had a mild speech delay and was otherwise doing well with his adoptive family.
Discussion: Our case highlights the importance of considering intoxication in the differential diagnosis of seizure-like activity in infants. Assessment of increased tone and abnormal mental status for age was key to the clinical diagnosis of serotonin syndrome in this infant, which was supported by the lab results.
Conclusions: Developmentally-specific physical exam identified serotonin syndrome in an infant.

KEYWORDS Pediatric; serotonin syndrome; physical exam

borka015@umn.edu

58. Characterization of cases of intoxication receiving aeromedical transport by a large regional aeromedical transport service

Axel Adams, Kyle Danielson, Matthew Valento, Andrew Latimer and Richard Utarnatchitt

University of Washington, Seattle, WA, USA

Background: Intoxicated patients are a significant proportion of patients transported by emergency medical services; however, few case series have been published characterizing the population requiring aeromedical transport. The largest case series to date have been performed in Japan, and no comparable case series exists in the US. In this retrospective observational case series, we characterize the population of intoxicated patients transported by a large regional aeromedical transport service in the time period of September 2009–September 2020 with the aim of improving understanding of aeromedical transport of intoxicated patients, care processes in transport, and outcomes.
Methods: The aeromedical transport service in this study is affiliated with a regional academic medical center and the level one trauma center for a broad geographic region. We queried the aeromedical transport service's electronic medical record for

cases of intoxication from September 2009 to September 2020. Demographic data, data related to pre-transport and intra-transport course, and destination hospital data were abstracted. If these cases were transported to the affiliated hospitals, hospital course data and outcome variables were abstracted. Outcome data were unable to be obtained for all other receiving hospitals. Patient files were reviewed by two reviewers.

Results: 166 cases of intoxication were transported by the service over the study time period. Nine cases were excluded (seven cases of foreign body ingestion and two cases of anaphylaxis), yielding $n = 157$ included cases. Of these, $n = 55$ (35.0%) were transported to transport service's affiliated hospitals, $n = 45$ (28.7%) were transported to regional pediatric hospitals, and the remainder $n = 57$ (36.3%) were transported to other local hospitals. $n = 86$ (54.8%) were female, and $n = 71$ (45.2%) were male. $N = 56$ (35.7%) cases were pediatric. Of those transported to the transport service's affiliated hospitals, average age was 41.8 years (SD =15.70 years), and most were polysubstance intoxications $n = 27$ (49.1%) with ethanol being the most common coingestant, $n = 19$ (34.5%). The most common single substance overdoses were toxic alcohols $n = 4$ (7.3%) and carbon monoxide $n = 4$ (7.3%). $N = 34$ (61.8%) were intubated prior to transport with 3 (5.5%) intubated during transport. $N = 40$ (72.7%) were admitted to the ICU, while $n = 2$ (3.6%) were discharged from the emergency department, one patient was transferred to the local hyperbaric oxygen center, and one patient died in the emergency department. One patient was placed on extracorporeal life support (duration 3 days), and $n = 6$ (10.9%) received hemodialysis. Average hospital length of stay was 7.87 days (SD =3.47 days), and four patients (7.3%) expired in hospital.

Conclusions: This is the largest study of intoxicated patients requiring aeromedical transport to a higher level of medical care and the first described in a US civilian population. Of those transported to the region's major level one trauma center and academic medical center, the majority of cases were polydrug intoxications, and most patients required ICU level care with airway support being a primary indication. Fatalities were similar to those described by other case series of intoxicated patients requiring aeromedical transport. Major limitations include the lack of analytic confirmation of intoxicants in most cases and the lack of outcome data for other receiving hospitals.

KEYWORDS Aeromedical transport; emergency medical services; extracorporeal life support

axeadams@uw.edu

59. Deep vein thrombosis in the setting of coagulopathy associated with brodifacoum-contaminated synthetic cannabinoid use

Benjamin Davies and Justin Arnold

Florida Poison Information Center Tampa, Tampa, FL, USA

Background: An outbreak of synthetic cannabinoids (SCs) contaminated with brodifacoum, a long-acting anticoagulant rodenticide, was first reported in a nationwide outbreak in 2018. Though coagulopathy and bleeding were common, no one in the 2018 outbreak developed deep vein thrombosis (DVT) or other evidence of a hypercoagulable state. We present a case of an individual without a history of thrombotic events who developed a DVT while being treated for severe coagulopathy associated with brodifacoum-contaminated synthetic cannabinoids in a similar outbreak in December 2020.

Case report: A 20-year-old male with no past medical history presented to an emergency department after experiencing hemoptysis and hematuria for 2 days. Upon arrival, his INR was >8. His hemoglobin, hematocrit, and platelet counts were normal. The patient admitted to using SCs and was suspected as being part of a larger local outbreak of SCs that were contaminated with brodifacoum. Vitamin K (10 mg IV and 50 mg PO TID) was started along with fresh frozen plasma (FFP), and the patient's INR rapidly improved. He then developed a hemothorax that required intubation, chest tube placement and drainage, additional FFP, and packed red blood cells. He was treated with additional Vitamin K and clinically improved. He remained hospitalized due to difficulty obtaining adequate outpatient supplies of Vitamin K and on day 18 the patient left the hospital against medical advice without any oral Vitamin K in hand. Nineteen days after he left the hospital, he returned to the emergency department complaining of leg pain. He was not bleeding, though his INR had risen to >8. Lower extremity venous duplex showed a right lower extremity DVT. The patient was restarted on high-dose Vitamin K with plans to place an IVC filter. A repeat lower extremity venous duplex showed bilateral DVTs. Two days later, the patient's leg pain resolved, and an angiogram of the lower extremities showed resolution of the DVTs. No IVC filter was placed, and the patient was discharged home on Vitamin K therapy. He is currently unreachable and lost to follow-up.

Discussion: SC use alone has been associated with blood clots. However, this is the first case where a patient developed bilateral DVT's despite having an unmeasurably high INR associated with both SC and brodifacoum exposure. One possible explanation may include a brief hypercoagulable state due to rapid reductions in protein C and S levels associated with initiation or recrudescence of brodifacoum toxicity, similar to that seen in warfarin. There are several limitations to this report, however. The poison center is unaware of additional exposures in between the patient's hospital stays, including use of Vitamin K or continued use of the contaminated SCs. Lastly, despite SCs' association with blood clots there are still several different unrelated possible causes of the patients bilateral DVT's. Trauma from the patient's thoracentesis, long periods of bed rest, and/or undiagnosed medical conditions all remain possible contributions to the development of his DVTs.

Conclusions: Clinicians should be aware that SCs may cause DVT's, even in anticoagulated patients. Rapid assessment and treatment for DVT's should be considered when patients show signs and symptoms of DVTs, despite significant coagulopathy.

KEYWORDS DVT; brodifacoum; coagulopathy

bdavies@tgh.org

60. "Hungry hungry hippo:" confirmed dihexazine overdose leading to antimuscarinic toxicity in a toddler

Zachary Schmitz[a] and Mark Su[b]

[a]NYU Langone Perelman Department of Emergency Medicine, New York, NY, USA; [b]New York City Poison Control Center, New York, NY, USA

Background: Dihexazine is a cyproheptadine salt. It is the primary ingredient in Apeten®, an appetite stimulant sold in the Dominican Republic (DR) without a prescription. Pediatric cyproheptadine overdoses are uncommonly reported and the clinical features of dihexazine overdose are not well described. We report a case of a 2-year-old boy who developed antimuscarinic toxicity after a 48-fold dosing error of dihexazine.

Case report: A previously healthy, 15.7 kg, 31-month-old boy presented to the emergency department (ED) for altered mental status. His mother previously obtained Apeten® from the DR. The active ingredient is 3 mg of dihexazine per dose. Three hours prior to arrival, she administered Apeten® to the boy for the first

time. Dosing instructions are to dissolve the powdered contents in 240 mL of fluid and administer 5 mL per dose, but the patient's mother gave him the entire package (144 mg of dihexazine, approximately 9.2 mg/kg) in one sitting. Two hours later, he developed altered mental status, agitation, and "twitching." In the ED, his initial vital signs were: BP, 108/72 mmHg; HR, 170 beats/min; RR, 30 breaths/min; T, 36.5 degrees C; O_2 saturation, 93% (RA). Physical examination was notable for mild agitation, dry mucous membranes, flushed skin, non-reactive pupils, and intermittent fasciculations. His electrocardiogram showed sinus tachycardia at a rate of 166 beats/minute with normal QRS and QTc intervals. Adenovirus was detected on a respiratory viral panel. His urine drug screen was positive for "TCA"; subsequent testing revealed a urine cyproheptadine concentration >100 ng/mL. The patient received 1mg of intravenous lorazepam and 20 mL/kg IV crystalloid fluid bolus with improvement in agitation and heart rate. He was admitted to the pediatric intensive care unit (PICU) for cardiac monitoring. In the PICU, he remained confused, was not following commands, and was unwilling to take anything by mouth. Examination by Toxicology at 14 h post-ingestion revealed persistent signs of antimuscarinic toxicity, but normal reflexes, tone and no clonus. One day after presentation, the patient's mental status, vital signs, and physical examination returned to his normal baseline with only supportive care. He was subsequently discharged home.

Discussion: Dihexazine (or dihexazina) is a cyproheptadine pyridoxal phosphate salt that acts as a H1, 5-HT1, and 5-HT2 receptor antagonists. Previous pharmacokinetic data on oral cyproheptadine hydrochloride is minimal, but two studies demonstrate a maximal onset of 4–9 h and elimination half-life of 8.6–16 h. To our knowledge, cases describing confirmed overdose with the dihexazine formulation in children are not reported. In our case, antimuscarinic symptoms started within 2 h of ingestion and resolved by 36 h.

Conclusions: Dihexazine is a cyproheptadine salt from the DR that may be used in appetite stimulant products. Overdose of dihexazine in children can lead to significant and prolonged antimuscarinic symptoms. Providers and parents should be cautioned about the use of dihexazine and the potential for its toxicity.

KEYWORDS Dihexazine; cyproheptadine; apeten

Zachary.schmitz@nyulangone.org

61. An analysis of exposures to medications contraindicated in pregnancy reported to US poison centers

Faisal Minhaj[a], James Leonard[b], Emily Paterson[b] and Wendy Klein-Schwartz[c]

[a]Wellstar Kennestone Hospital, Atlanta, GA, USA; [b]Maryland Poison Center, Baltimore, MD, USA; [c]University of Maryland School of Pharmacy, Baltimore, MD, USA

Background: Poison exposures during pregnancy may result in serious harm to the mother and fetus. Calls to the poison center for pregnant patients are rare but account for about 2.8% of poison center calls in women aged 15–45 years. Pregnant women often have a lower threshold to seek care when there is a potential threat to their or their unborn child's health. We examined a comprehensive database of pregnancy exposures compared to a non-pregnant female cohort. This is a subgroup analysis of that study examining specifically medications that are contraindicated in pregnancy (MCIP).

Methods: The National Poison Data System was queried for all exposures involving pregnant women from 2000 to 2019. From this large group, exposures were limited to only medications. Each medication was checked whether it was contraindicated in pregnancy using REPROTOX®, a database that contains summaries on the effects of medications and a comprehensive resource on teratogenicity. Exposures were classified if they were teratogenic or not, e.g., if there was known harm to a developing fetus; this was broken down by trimester. We compared differences for exposures involving MCIP and those that did not (NCIP).

Results: There were 54,677 exposures with medications obtained from the parent data set. Of these, 13,602 (24.9%) were MCIP. Mean age was similar in MCIP and NCIP, 25 (IQR 21, 30) vs 26 (IQR 21, 31), as was trimester of exposure, majority in the first (36% vs 32%) and second (35% vs 36%). The MCIP group had a higher rate of intentional – abuse (7.0% vs 1.2%) and suspected suicide (41% vs 32%), and fewer therapeutic errors (20% vs 31%). The MCIP group was most often already enroute to or referred to a health care facility (68.0%), compared to the NCIP group (49.4%). Of those that were in a health care facility, the level of care required was not different between the two groups. However, the MCIP had more exposures that resulted in moderate and major effects than the NCIP group (13.9% vs 10.9%) and fewer cases that were not followed or had an unrelated effect (40.5% vs 49.7%). The most common medications in the whole population were acetaminophen alone, multivitamins, opioids, pyrethroids, and antibiotics. Within the MCIP group the most common medications were opioids, ibuprofen, other selective serotonin reuptake inhibitors, aspirin alone, and naproxen; these did not change by trimester of exposure.

Conclusions: About one-fourth of all pregnancy medication calls to US poison centers involved a medication that is contraindicated in pregnancy. Exposures involving an MCIP were more likely to be secondary to suicide attempt or abuse, and result in more severe effects.

KEYWORDS Pregnancy; contraindication; opioids

Faisal.Minhaj1@gmail.com

62. Characteristics and outcomes of bupropion overdose patients in the Toxicology Investigators Consortium (ToxIC) registry

Rawan Safa and David Liss; On behalf of the Toxicology Investigators Consortium (ToxIC)

Washington University in St. Louis, St. Louis, MO, USA

Background: Bupropion use, whether for therapeutic or recreational purposes, has been on the rise. Seizure is a common sequela of bupropion poisoning. Prior research into bupropion poisoning often excludes co-ingestants. The purpose of this study is to describe the demographics and outcomes of bupropion overdose patients entered into the Toxicology Investigators Consortium (ToxIC) Registry. Our study aims to analyze co-ingestants, including benzodiazepines, and association with the incidence of seizure or other outcomes.

Methods: This is a retrospective study using the ToxIC Registry, which is a multicenter toxico-surveillance and research network of medical toxicologists. Patients who presented with bupropion ingestion between 2016 and 2020 were included. Analyzed variables included demographics (age, gender, and race), toxic exposures, clinical findings during encounter including vital sign abnormalities and electrocardiogram (ECG) changes, incidence of seizure post-exposure, and clinical outcomes including intubation, arrhythmia, coma, and death. Data regarding seizure occurrence were also compared between patients who had a benzodiazepine co-ingestion versus those who did not.

Results: The ToxIC registry had records on 1065 patients with bupropion overdose. Among these, 592 (55.6%) were between the age of 19–65 years. Most subjects were female, 650/1065 (60.8%). Tachycardia (heart rate >140 beats per minute) developed during hospitalization in 309 patients (28.9%). A total of 164 patients (15.3%) had QTc >500 milliseconds on initial ECG, and 176 patients (16.5%) were intubated. Moreover, 328 patients (30.7%) experienced seizure. Among bupropion overdose patients in the registry, 67 (6.3%) received activated charcoal for decontamination. The incidence of seizure in patients who co-ingested benzodiazepines was 7.7% (5/65) compared to 32.3% (323/1000) in those who did not. Ingestion of benzodiazepines with bupropion was associated with lower odds of seizure (OR 0.175, 95 CI =0.069–0.439). Additionally, patients who did not co-ingest benzodiazepine were more likely to present with tachycardia (29.9% vs 15.4%, $p = 0.012$). Interestingly, 26.2% of patients who co-ingested benzodiazepines were intubated, compared with 15.9% of those who did not co-ingest benzodiazepines ($p = 0.031$). This could be related to the fact that bupropion overdose patients who co-ingested benzodiazepines had a higher incidence of altered mental status on presentation (56.9% vs 23.8%, $p < 0.001$). A total of 7 patients (0.7%) died during their hospitalization; 2 in the benzodiazepine co-ingestant group and 5 in the group without benzodiazepine co-ingestion.
Conclusions: This study is consistent with a prior study of poison center patients with bupropion overdose. When benzodiazepines are ingested along with bupropion, seizures appear to be less common than when bupropion is ingested without benzodiazepines. Prospective research analyzing risk of seizure from bupropion in the presence or absence of benzodiazepine coingestants may lead to human trials of prophylactic benzodiazepines in the setting of bupropion overdose to prevent seizure.

KEYWORDS Bupropion overdose; benzodiazepine; seizure

rawan.safa@wustl.edu

63. Delayed leukopenia following intentional azathioprine ingestion

Jason Devgun
Washington University, St. Louis, MO, USA

Background: Azathioprine is a purine analog metabolized to 6-mercaptopurine (6-MP) utilizing glutathione. Its high oral bioavailability and longer duration of action make it viable as a treatment for ulcerative colitis or as an anti-rejection medication for renal transplant patients. Specific experience in overdose with this agent is limited although toxicity mimics 6-MP including hepatotoxicity, delayed leukopenia, and acute interstitial nephritis.
Case report: A 46 year old female (64 kg) with a history of ulcerative colitis, migraines, and anxiety presented with a self-reported intentional ingestion of 1000 mg azathioprine and presented to care approximately 8 h post-ingestion. Her compliance with azathioprine preceding the ingestion was unclear. She reported taking her other medications as prescribed (tadalafil, sulfasalazine, fioricet, alprazolam) the day prior to presentation. Other than one episode of emesis without pill fragments, myalgias, headache she had no other symptoms. Her presenting vital signs were HR 84, RR 22, BP 90/63, T 36.2 °C. Initial labs included a normal chemistry profile, undetectable serum acetaminophen and salicylates, an ethanol level of 50 mg/dL and venous lactate of 1.6 mmol/L. She received a total of 3 L of crystalloid IV fluids with improvement in blood pressure to 125/66 and was transferred for higher level of care. Due to the delay in presentation and well appearance, activated charcoal and hemodialysis were considered but deferred. While inpatient she had laboratory evaluation including CBC and differential every 8 h. In the ED she developed a fever, 38.1 °C. PCR testing for COVID-19 was negative. Whole blood thiopurine metabolites (Prometheus Biosciences, Test 3200) were sent approximately 33 h from time of ingestion. 6-thioguanine levels were 108 pmol/8 × 10○8 RBC, below the therapeutic reference range (230–400 pmol/8 × 10○8 RBC). 6-methylmercaptopurine metabolites were below the lower limit of quantification (761 pmol/8 × 10○8 RBC). Genetic testing for thiopurine S-methyltransferase was declined by the patient. She was hospitalized for 4 days and did not develop any substantial vital sign abnormalities or creatinine elevation. Her absolute neutrophil count dropped to 500/mm^3 approximately 76 h post-ingestion, but started to improve 84 h post-ingestion and granulocyte-macrophage colony-stimulating factor was deferred. Her peak AST was 113 IU/L, approximately 46 h post-ingestion and returned to normal (16 IU/L) upon follow-up 7 days post-ingestion. White blood cell count 7 days post-ingestion was 4.3 K/mm^3.
Discussion: Azathioprine overdose is rarely reported in the literature. Case reports describe delayed leukopenia and hepatotoxicity from repeat supratherapeutic ingestions, however, based upon limited experience serious toxicity from single acute ingestions appears rare. A report of a single acute ingestion of 7500 mg of azathioprine resulted in moderate leukopenia (4.1 K/mm^3) 3 days post-ingestion. Peak immunosuppressive effects can take up to 2 weeks from initiation or change in dose. Symptoms in this case are consistent with effects from azathioprine including vomiting, transient hypotension, and myalgias.
Conclusions: Intentional ingestions of azathioprine are infrequently reported and can result in serious delayed myelosuppression. We report a case of a single acute ingestion of >15 mg/kg resulting in delayed myelosuppression managed conservatively.

KEYWORDS Azathioprine; leukopenia; myelosuppression

jdevgun@wustl.edu

64. Recovery after poly-drug overdose despite blood flow imaging demonstrating no brain perfusion

Edward Bottei and Grant Houselog
Iowa Poison Control Center, Sioux City, IA, USA

Background: The determination of brain death can be complicated in some cases and can be aided by ancillary testing. We report the case of a 42 y/o woman with profound CNS depression from a poly-drug overdose who had no evidence of brain blood flow on nuclear medicine vascular flow imaging yet recovered to be discharged to psychiatric care.
Case report: A 42 y/o woman was found unresponsive with empty bottles of tizanidine 4 mg, eszopiclone 2 mg, and hydroxyzine 50 mg nearby. Initial vital signs were HR 110 bpm, RR 16 bpm, BP 114/68 mmHg, O2 saturation 92% on room air with 2 nasal trumpets in place. Notable initial labs were blood gas with respiratory acidosis, no metabolic acidosis, no elevation of serum osmolality, creatinine 1.0 mg/dL, APAP <2 mcg/mL, ASA <2 mg/dL, EtOH <3 mg/dL, and urinalysis 2+ calcium oxalate crystals. Patient was intubated due to having no gag reflex, being unresponsive to painful stimuli, and having seizures approximately every 30 min. She was sedated with continuous IV midazolam and propofol. Sodium bicarbonate bolus and infusion were started for a QRS of 112 mSec. Hypotension responded to norepinephrine and seizures were treated with levetiracetam and lorazepam. On hospital day 2, her sedation was turned off for 6 h but restarted after the patient seized. On hospital day 3, the patient was sedated with midazolam 4 mg/h and propofol 20 mcg/kg/min. Norepinephrine was at 0.01 mcg/kg/min with a

HR of 88 bpm and BP of 101/56 mmHg. She was reported to have no corneal, cough or gag reflexes, and was taken to nuclear medicine for a brain blood flow scan. The scan showed no dynamic perfusion in the cerebrovascular system over 3 min and delayed frontal and lateral images showed no tracer activity within the brain but some uptake in the nasal region. On hospital day 4, sedation was changed to dexmedetomidine 0.8 mcg/kg/h and propofol 15 mcg/kg/min. Norepinephrine was stopped. The patient began following simple commands. EEG showed moderate encephalopathy, but no cerebral silence, and no seizures. She had progressive neurological improvement, was extubated on hospital day 8 and transferred to behavioral health in good condition on hospital day 11.

Discussion: Determination of brain death can be difficult in some situations and professional groups have published extensive guidelines for the determination of brain death. In general, brain death criteria include unresponsiveness to noxious stimuli, absence of multiple brain stem reflexes, and apnea despite the elevation of pCO_2. Ancillary testing, such as detection of brain blood flow or somatosensory evoked potentials, can be used if neurological exam findings are equivocal or the apnea test cannot be performed. Negative brain blood flow on nuclear imaging, as found in this case, is considered to be consistent with the diagnosis of brain death. There are only a few case reports, one of which has been retracted, that demonstrated clinical recovery after a nuclear medicine scan showed no blood flow within the brain. Overdoses with certain medications are known to mimic brain death, baclofen and barbiturates being two of the best known. No reports of an intoxication mimicking brain death could be found which also reported the results of a brain perfusion scan.

Conclusions: We present the case of a poly-drug overdose patient who had no cerebrovascular blood flow on nuclear medicine imaging yet recovered back to her baseline.

KEYWORDS Nuclear medicine brain blood flow; brain death mimic; brain death determination

Grant.Houselog@unitypoint.org

65. Clinical presentation and management of oral potassium poisoning: a retrospective review of the national poison data system 2010–2021

Rita Farah[a], Joseph Carpenter[a], Stephanie Hon[b], Robert Geller[c] and Brent Morgan[a]

[a]Department of Emergency Medicine, Emory School of Medicine, Georgia Poison Center, Atlanta, GA, USA; [b]Georgia Poison Center/Grady Health System, Smyrna, GA, USA; [c]Georgia Poison Center/Department of Pediatrics, Emory University School of Medicine, Atlanta, GA, USA

Background: Hyperkalemia is a potentially life-threatening electrolyte abnormality commonly seen in the Emergency Department. The literature on potassium overdose is limited to case reports or case series of up to 13 cases. Available literature shows significant variability in the management of potassium poisonings. We present the results of data extraction of 44 exposures to single agent oral potassium salts reported to the National Poison Data System (NPDS) that resulted in a major outcome or required acute management.

Methods: This was a retrospective review of NPDS from January 2010 to June 2021. During the study period, 1741 cases involving single-agent oral potassium ingestion, with known outcome, were reported. We requested case narratives from the individual member sites for 44 exposures that resulted in a major outcome and for cases that required acute management such as decontamination, stabilization of the myocardium, intracellular shifting or enhancing elimination. We classified hyperkalemia as mild (peak potassium level (ppl) < 6.5 mEq/L; $n = 18$), moderate ($6.5 \leq$ ppl < 8 mEq/L; $n = 12$) or severe (ppl ≥ 8mEq/L; $n = 11$). We performed bivariate analyses to assess signs and symptoms and management associated with severe hyperkalemia.

Results: Analyzing data extracted from case narratives of 44 exposures, extended release formulation was reported in 20/44, the median dose ingested was 600 mEq (IQR 400–1600), and the maximum reported dose was 2100 mEq. The median peak potassium concentration was 7.2 mEq/L (range 3.9–10.3 mEq/L). We found a moderate positive correlation between dose ingested and peak potassium concentration ($r = 0.6$; $p < 0.001$). Electrocardiographic pathologic signs were the most frequent finding (22/44) including peaked T waves (12/44), QRS widening (6/44), bradycardia (8/44), and asystole (4/44). Patients who experienced asystole had a potassium level between 9.2 and 10.3 mEq/L. Neurological symptoms including central nervous system depression, confusion, neuromuscular weakness and paresthesia were reported in 17/44. Gastrointestinal (GI) symptoms were reported in 14/44. Severe hyperkalemia was significantly associated with QRS widening ($p = 0.002$), peaked T waves ($p = 0.013$) and neurological symptoms ($p = 0.022$) but not with GI symptoms($p = 0.28$). Endoscopic removal of pills was not recommended nor performed in any of the 44 cases. Whole bowel irrigation (WBI) was significantly associated with mild hyperkalemia ($p = 0.009$). In contrast, hemodialysis was associated with severe hyperkalemia ($p < 0.001$), and using calcium ($p < 0.001$), insulin ($p = 0.002$) or alkalinization were significantly associated with moderate to severe hyperkalemia ($p < 0.001$). Pattern of use of cation-exchange resin (23/44), albuterol (15/44), furosemide (17/44) did not appear to be influenced by the severity of hyperkalemia. Clinical presentation with any electrocardiographic pathologic signs was significantly associated with interventions aiming at cardiac protection and promoting intracellular shift including calcium ($p < 0.001$), insulin ($p = 0.008$) and serum alkalinization ($p = 0.007$).

Conclusionss: The presented data suggest that aggressive medical management aiming at cardiac protection and promoting intracellular shift are triggered by electrocardiographic pathologic signs while hemodialysis decision is influenced by higher serum potassium level. Further analysis should aim at investigating the association of WBI with mild hyperkalemia.

KEYWORDS Oral potassium poisoning; clinical presentation and management; NPDS

rita.jean.farah@emory.edu

66. Eastern diamondback rattlesnake envenomation with severely elevated compartment pressures despite antivenin administration

Brandtly Yakey[a], Mirjana Dimovska[b], Andrew Isaacson[c], Rahul Vaidya[d] and Bram Dolcourt[b]

[a]Wayne State University Michigan Poison and Drug Information Center, Detroit, MI, USA; [b]Department of Emergency Medicine, Wayne State University School of Medicine, Detroit, MI, USA; [c]Michael and Marian Ilitch Department of Surgery Wayne State University School of Medicine, Detroit, MI, USA; [d]Department of Orthopedics, Wayne State University School of Medicine, Detroit MI, USA

Background: Compartment syndrome is a rare complication following pit viper envenomation. Fasciotomy, a once more frequently employed intervention for venomous snakebites, is now

reserved for select cases. We present a case involving envenomation from an eastern diamondback (*Crotalus adamanteus*) rattlesnake resulting in significant toxicity, ultimately warranting fasciotomy.
Methods: 56-year-old male on apixaban was envenomated by his pet eastern diamondback rattlesnake on his right thumb. He developed dysphonia and oropharyngeal edema requiring rapid sequence intubation upon presentation. Examination was significant for a puncture wound of the thumb with circumferential soft tissue swelling extending proximally to the elbow. Shortly thereafter, he developed hypotension and rash. Treatment with epinephrine, antihistamines and steroids was initiated for presumed anaphylactic shock.
Results: Six vials of crotalidae polyvalent immune Fab (PVIF) were administered after transfer to a tertiary facility. Laboratory results reflected a venom-induced consumptive coagulopathy. He received: one unit of platelets and 6 more vials of PVIF 3 h and 10 vials of crotalidae immune $(Fab')_2$ 9 h after arrival. Swelling progressed and compartment pressures increased to >80 mmHg. Fasciotomy was performed at hour 12. Another four vials of $(Fab')_2$ were administered 21 h post-arrival. There was no recurrence of coagulopathy and tissues remained viable. He was discharged on hospital day 17.
Discussion: Compartment syndrome rarely develops following pit viper envenomation; when present, it can be treated appropriately with antivenin. Surgical fasciotomy should be considered in the presence of severely elevated compartment pressures.
Conclusions: Local hemorrhage and coagulopathy are characteristic following pit viper envenomation and rarely lead to the development of compartment syndrome. Fasciotomy is indicated for severely elevated compartment pressures despite appropriate antivenin administration. When medical futility can be declared is unclear and warrants further investigation.

KEYWORDS Eastern diamondback; fasciotomy; antivenin

ci7465@wayne.edu

67. Andexanet alfa vs 4-factor prothrombin complex concentrate for intracranial hemorrhage at a level I trauma hospital

Kelly Considine[a], Ryan Fuchs[b], Anthony Severt[a], Brian Driver[a], Jed Gorlin[a], Lisa Hodson[a] and Jon Cole[b]

[a]Hennepin Healthcare, Minneapolis, MN, USA; [b]Minnesota Poison Control System, Minneapolis, MN, USA

Background: Andexanet alfa (AA) was FDA approved in 2018 and subsequently added to societal guidelines for the reversal of bleeding associated with the factor X inhibitors (FXi), apixaban and rivaroxaban. AA was added to our hospital formulary in late 2018 for central nervous system hemorrhage and has been primarily utilized as first-line therapy for FXi-associated intracranial hemorrhage (ICH). Prior to AA's addition to our formulary, patients with FXi-related intracranial hemorrhages were treated with 4-factor Prothrombin Complex Concentrate (4F-PCC). A prospective comparison trial has not yet been published to demonstrate superiority of a reversal method between AA and 4F-PCC. For effectiveness, safety, and cost reasons, we sought to compare outcomes of the two reversal strategies in patients with FXi-related traumatic and spontaneous intracranial hemorrhage.
Methods: We conducted a retrospective review of all patients who received 4F-PCC or AA for an intracranial hemorrhage while being treated with a FXi from October 2015 to August 2021. Our primary outcomes included the good or excellent hemostatic effectiveness (ICH volume change on head CT) and good functional outcome (Glasgow Outcome Score [GOS] > 3 at discharge). A radiologist, who was blinded to the reversal agent each patient received, calculated the hemorrhage volume for each patient before and after reversal. Secondary outcomes included hospital length of stay, incidence of thrombosis, discharge location, cost, and pre- and post-reversal apixaban and rivaroxaban drug concentrations. Our coagulation laboratory created an assay based on anti-Xa levels to provide apixaban and rivaroxaban levels, which were recorded before and after treatment.
Results: A total of 49 patients (25 in the AA group, median age 75 years and 24 in the 4F-PCC group, median age 82 years) with a FXi-related ICH were evaluated. Baseline characteristics were similar between groups, with most hemorrhages being traumatic. We found no difference in hemostatic effectiveness (4F-PCC: 65% excellent, 0% good; AA: 50% excellent, 18% good) or good functional outcome (4F-PCC: 54% GOS >3, AA: 56% GOS >3). Logistic regression models (adjusting for age, pre-reversal ICH volume, and cause of hemorrhage) for both hemostatic effectiveness and good functional outcome revealed no difference between groups. Death was less common in 4F-PCC patients ($n = 3$) than AA patients ($n = 9$). Post-reversal apixaban and rivaroxaban concentrations were similar between groups. The only post-medication thromboses occurred in two AA patients (1 DVT, 1 CVA). Patients who received AA had longer hospital lengths of stay and fewer patients were discharged home compared to 4F-PCC. The median cost per patient for FXi reversal was higher for AA ($33,000/reversal) than for 4F-PCC ($4963/reversal), representing a total spending increase of approximately $532,703 over 4F-PCC after the introduction of AA.
Conclusions: We found no difference in hemostatic effectiveness or good functional outcome when either 4F-PCC or AA were used for apixaban or rivaroxaban-related ICH at a Level I trauma center. Median cost per patient was $28,037 higher for AA. High quality prospective data are needed to determine if AA or 4F-PCC is superior for FXi-related ICH.

KEYWORDS Andexanet alfa; 4-factor prothrombin complex concentrate; factor X inhibitors

kelly.considine@hcmed.org

68. Extracorporeal membrane oxygenation utilization for vasoplegic shock due to pediatric toxic ingestions

Lesley Pepin[a], HoanVu Nguyen[a], Stephanie Kilgore[b], John S. Kim[b] and George Sam Wang[c]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]School of Medicine, University of Colorado, Aurora, CO, USA; [c]University of Colorado Anschutz Medical Campus, Aurora, CO, USA

Background: Veno-arterial extracorporeal membrane oxygenation (VA-ECMO) is traditionally used to support patients with cardiogenic shock. Toxin induced cardiogenic shock is temporary and reversible, making poisoned patients ideal candidates. This intervention can be lifesaving, but carries unique risks and is resource intensive. Currently, no objective criteria exist for ECMO use across poisoned patients. VA-ECMO for toxin related vasoplegic shock is less described in the literature. ECMO is a form of cardiopulmonary bypass that supports impaired tissue oxygenation delivery; however, concerns regarding potential adequacy of support in the context of this vasoplegia remains. The objective of this study was to describe the use of VA-ECMO in children with vasoplegic shock from a toxicological etiology.

Methods: This was a retrospective case review of the institutional ECMO database for pediatric patients who received VA-ECMO for vasoplegic shock related to poisoning at a quaternary pediatric referral center. Vasodilatory shock was defined as hypotension requiring pressor support with the absence of significant myocardial dysfunction (normal or low-normal left ventricular systolic function) by echocardiography. We collected demographic information, details regarding exposure and pre/post ECMO variables including hemodynamic parameters, acid/base data, continuous renal replacement therapy (CRRT) use, cannulation site, Vasoactive Inotropic Score (VIS), ECMO complications and survival to discharge. This study was approved by the Institutional Review Board.
Results: A total of 16 consecutive patients were identified from the institutional ECMO database. Of those, 10 patients requiring VA-ECMO support for vasoplegic shock were studied. Six patients were excluded: cardiac arrest without vasoplegia (2), acute respiratory distress syndrome (2), myocardial failure (1), and refractory tachydysrhythmia (1). The median age was 16 years (interquartile range 1.4) and 9 were female. Half had a polypharmacy ingestion and over half (6) required specific antidotal therapy prior to ECMO initiation. Six patients also required CRRT. Median time on VA-ECMO support was 1.7 days (range: 0.6 to 4.6 days). Median VIS just prior to VA-ECMO initiation was 102.5 (range: 23–388). Vasopressors utilized include epinephrine, norepinephrine, dopamine, and vasopressin. Median nadir blood pH and base deficit preceding ECMO were 7.13 (range: 6.92–7.24) and −18.2 mmol/L (range: −27 to −10), respectively. Median peak lactate was 7.83 mmol/L (range: 6.4 to 22). Five patients had ECMO complications (3 stroke, 1 cannula dislodgement, and 1 patient upper GI bleed and compartment syndrome). Eight patients survived to hospital discharge.
Conclusions: In this retrospective study, VA-ECMO was used for toxin-induced vasoplegic shock without cardiac dysfunction. Survival rate was 80%; however, there was a 50% complication rate. There was a large range of biomarker indications, but all patients had metabolic acidosis and high VIS prior to ECMO. Use of CRRT was likely helpful in the care of these poisoned patients to correct acidosis or potential toxin removal. These findings demonstrate the need for further research to determine which patients are candidates for VA-ECMO, along with objective markers and indications for ECMO to maximize survival while limiting complications.

KEYWORDS Extracorporeal membrane oxygenation; vasoplegic shock; pediatric toxicology

lesley.pepin@rmpds.org

69. A unique case of an intraoperative iatrogenic methanol exposure

Andrew Micciche[a], Eric Johnson[a], Breanne Mefford[a], Amber McCoy[a], Peter Akpunonu[b], Mehboob Kalani[a] and Ashish Maskey[a]

[a]University of Kentucky, Lexington, KY, USA; [b]Department of Emergency Medicine, University of Kentucky, Lexington, KY, USA

Background: ThinPrep® Cytolyt is a methanol-based cell preservation solution used to support biopsied cells during transport and slide preparation. Cytolyt is frequently used to fix tissue samples immediately following an endobronchial ultrasound-guided fine needle aspiration. We report the only known case of an accidental intraoperative administration of a methanol solution, with corresponding plasma concentrations, and successful treatment with fomepizole.
Case report: The patient is a 70-year-old 58 kg female with a history of stage IIIA rectal adenocarcinoma with metastasis to the regional lymph nodes and a recently discovered lung mass. The patient was referred to interventional pulmonology for evaluation. During their procedure, a bronchoalveolar lavage (BAL) was performed by instilling 30 mL of fluid, believed to be normal saline, into the right upper lobe. A 10 mL volume was then aspirated for the purpose of culture collection. Shortly after the BAL, the proceduralist was informed the aforementioned syringe contained CytoLyt, a methanol-based fixative used for cytopathology, instead of saline. Upon arrival to the PACU, the patient promptly received a 15 mg/kg dose of fomepizole (890 mg) for treatment of possible methanol toxicity. An arterial blood gas (ABG) was collected, showing the following: 7.35/47/216/25, with an oxygen saturation of 99.9%. The patient's first plasma methanol level, prior to fomepizole administration, returned elevated at 21 mg/dL. Three hours after fomepizole administration, the plasma methanol level had decreased to 13 mg/dL, and at both 8 h and 18 h the plasma methanol level was 12 mg/dL. No additional fomepizole was administered after the loading dose and the patient never developed a metabolic acidosis or other adverse sequelae.
Discussion: Methanol (methyl alcohol) is a toxic alcohol found in a variety of commercial agents, and toxicity is well established via ingestion, dermal absorption, and even inhalation. Administration via BAL has not been previously documented, however some degree of systemic absorption would be expected. Aside from possible direct irritant effects, the biggest concern with this exposure to Cytolyt was the potential for systemic methanol toxicity, considered to be a risk at plasma methanol concentrations of 20 mg/dL or greater. Methanol mediates its toxicity via generation of metabolic acidosis due to accumulation of formic acid, which is further exacerbated by formic acid's inhibition of the electron transport chain and oxidative phosphorylation. Following exposure, patients will exhibit a metabolic acidosis with potential for blindness, hemodynamic instability, and possibly death if untreated. Clinical symptoms correlate more with the severity of the acidosis and less with the actual methanol level at any one time. In our patient, exposure to methanol was detected almost immediately, allowing for expeditious initiation of antidotal therapy.
Conclusions: We present the case of a patient who developed a potentially toxic plasma methanol level following iatrogenic BAL administration of a methanol solution. The patient was treated with fomepizole and did not develop systemic toxicity. Providers utilizing CytoLyt® and any similar products should be aware of this potential error and approach the possibility of methanol toxicity as they would for other routes of methanol exposure.

KEYWORDS Iatrogenic; methanol; exposure

afmi222@uky.edu

70. Dihydroergotamine extravasation: prolonged arterial vasospasm requiring medical and surgical treatment

Kelsey Martin[a], Kapil Sharma[b], Kerollos Shaker[a] and Jason Fuller[a]

[a]UT Southwestern, Dallas, TX, USA; [b]University of Texas Southwestern Medical Center, Dallas, TX, USA

Background: Dihydroergotamine (DHE) is a semi-synthetic ergot alkaloid once common in treating migraines and refractory headaches. DHE is thought to be effective for headaches due to its action on the serotonergic receptors in the brain. The main adverse effect of concern is vasoconstriction as the coronary and peripheral arteries contain these same serotonin receptors. Diffuse peripheral vasoconstriction is well reported in the

literature; however, there are few cases of localized vasospasm at the site of infusion.
Case report: A 40-year-old patient receiving DHE infusion via a midline brachial vein catheter for migraines developed severe pain at the site of the DHE infusion which was subsequently stopped. She was noted to have extravasation of the DHE and developed increasing pain and paresthesias in her hand along with a decreased radial pulse. Doppler arterial ultrasound demonstrated focal narrowing of the brachial artery at the site of infusion. Topical nitroglycerin was placed over the focal artery stenosis without improvement followed by subcutaneous phentolamine (5 mg). Pain and diminished radial pulses persisted with repeat imaging showing worsening stenosis with proximal extension. Nitroprusside drip was not tolerated due to hypotension. She was taken for angiography which showed severe spasm of the right brachial artery with decreased distal flow. There was an incomplete response to intra-arterial nitroglycerin injection and balloon angioplasty was subsequently performed. Following the procedure, brisk outflow of the brachial artery was observed with an improved vascular filling of the hand. The patient reported improvement in her symptoms with only minimal tingling of her fingertips. She was discharged 5 days after the initial extravasation event with minimal symptoms of her RUE.
Discussion: This case describes a 40-year-old woman with brachial artery vasospasm requiring intra-arterial nitroglycerin and angioplasty following suspected extravasation of dihydroergotamine that she was receiving for migraine treatment. DHE is now infrequently used for this indication due to its potential adverse effects and availability of other agents. Diffuse peripheral arterial spasm with limb threatening ischemia has been reported with IV infusion; however, no cases of local vasoconstriction due to extravasation have been reported to our knowledge. The use of subcutaneous DHE is generally well tolerated and proximity of the extravasation to the brachial artery likely played a significant role in causing vasospasm. We suggest caution in the use of proximal IV catheters, particularly those situated adjacent to arteries when administering DHE. Vasospasm and subsequent ischemia are well described in the use of ergots; however, there is little literature on extravasation into the tissues and the use of angioplasty in vasospasm secondary to DHE. Complications arising from extravasation of vasopressors may be similar to that of DHE given both pose a risk of ischemia due to excess constriction of peripheral vasculature. Phentolamine, a recognized treatment of vasopressor extravasation, did not help in this case. Of note, the patient also reported a history of Raynoud's Phenomenon which may have contributed to the vasospasm.
Conclusions: IV DHE administration can lead to significant, persistent vasospasm requiring intra-arterial vasodilators and angioplasty in order to prevent permanent ischemic damage to the affected limb.

KEYWORDS Dihydroergotamine; vasospasm; angioplasty

kelseykathleenmartin@gmail.com

71. Veratrum parviflorum poisoning: identification of steroidal alkaloids in patient blood and breast milk

Jared Seale[a], Joseph Carpenter[b], Matthew Eisenstat[c], Emily Kiernan[b], Brent Morgan[b], Daniel Nogee[b], Xinzhu Pu[d], Colin Therriault[e], Michael Yeh[b] and Owen McDougal[f]

[a]Boise State University, Boise, ID, USA; [b]Department of Emergency Medicine, Emory School of Medicine, Georgia Poison Center, Atlanta, GA, USA; [c]Department of Emergency Medicine, University of Louisville, Louisville, KY, USA; [d]Biomolecular Research Center, Boise State University, Boise, ID, USA; [e]Department of Emergency Medicine, University of Illinois College of Medicine at Peoria, Peoria, IL, USA; [f]Department of Chemistry and Biochemistry, Boise State University, Boise, ID, USA

Background: Plants in the genus *Veratrum* contain steroidal alkaloids that can lead to poisoning if ingested. Symptoms include nausea, vomiting, and a triad of bradycardia, hypopnea, and hypotension known as the Bezold-Jarisch reflex. Inadvertent ingestion may occur when *Veratrum* species are misidentified and mistaken for edible plants such as ramps (*Allium tricoccum*). We describe eight patients who foraged and ate *Veratrum parviflorum* and became symptomatic, with analysis of blood and breast milk samples for *Veratrum* alkaloids.
Methods: Eight patients presented to emergency departments for medical attention after ingestion of *Veratrum parviflorum*. Symptoms included gastrointestinal distress with nausea, vomiting, and abdominal cramping, as well as symptomatic bradycardia, hypotension, generalized weakness, visual disturbances, and lightheadedness. Four patients were hospitalized, with two requiring ICU admission due to severe hypotension and bradycardia, while others were observed in the ED and discharged. All patients gave written consent for further analysis of biological specimens. *V. parviflorum* plant material, patient blood, and breast milk were analyzed using high performance liquid chromatography-quadrupole time of flight mass spectrometry (HPLC-QTOF).
Results: Extracts of *V. parviflorum* plants contained the alkaloids cyclopamine, veratramine, jervine, and muldamine. Although jervine and muldamine are known to occur in other *Veratrum* species, this is the first documented report of their presence in *V. parviflorum*. Three of the eight patients had detectable levels of *Veratrum* alkaloids in the blood, with cyclopamine, jervine and veratramine identified. Breast milk samples also contained cyclopamine and veratramine. One patient had a positive digoxin clinical chemistry assay, but no detectable *Veratrum* alkaloids in blood. Most patients responded well to supportive care, IV fluids, and antiemetics, and four were discharged after several hours of ED observation. As the clinical presentation of *Veratrum* poisoning may mimic intoxication with cardioactive steroids such as convallatoxin found in Lily of the Valley, two patients initially received empiric treatment with digoxin immune Fab, with no discernable clinical response. Two patients with persistent hemodynamic instability were treated with atropine, norepinephrine, and dopamine in the ICU. There was no association between presence of *Veratrum* alkaloids or positive digoxin assay with symptom severity. All patients recovered within 48 h, with no known sequelae.
Conclusions: Ingestion of *Veratrum parviflorum* can result in severe bradycardia and hypotension requiring atropine and vasopressors, but most patients with milder symptoms respond well to supportive care. Symptoms, time of onset, and duration of illness reported in this study are consistent with previously described cases of *V.* parviflorum ingestion. *Veratrum* alkaloids may be present in blood and breast milk, suggesting the possibility of secondary exposure in nursing infants.

KEYWORDS Veratrum poisoning; false hellebore; steroid alkaloids

jaredseale@u.boisestate.edu

72. A comparison of snakebite patients in those with and without diabetes

Sukhshant Atti[a], Rita Farah[b], Michael Beuhler[c], Kerollos Shaker[d], Kim Aldy[e], Sharon Campleman[e], Paul Wax[f], Jeffrey Brent[g] and Anne-Michelle Ruha[h]; On behalf of the ToxIC North American Snakebite Study Group

[a]University of Alabama at Birmingham, Birmingham, AL, USA; [b]Emory University School of Medicine, Atlanta, GA, USA; [c]Carolinas Medical Center, Charlotte, NC, USA; [d]Farmers Branch, Dallas, TX, USA; [e]American College of Medical Toxicology (ACMT), Phoenix, AZ, USA; [f]University of Texas Southwestern, Paradise Valley, AZ, USA; [g]School of Medicine, University of Colorado, Denver, CO, USA; [h]Banner – University Medical Center Phoenix, Phoenix, AZ, USA

Background: There is limited literature examining the impact of co-morbidities like diabetes on the clinical course of snake envenomation. This report summarizes epidemiology and characteristics of snake envenomation in patients with the co-morbid condition of diabetes in comparison to those without, as reported to the Toxicology Investigators Consortium (ToxIC) North American Snakebite Registry (NASBR), a multi-center registry of patients that receive a consultation by a medical toxicologist.
Methods: We conducted an analysis of snakebite cases submitted to the ToxIC NASBR between January 1, 2013 and December 31, 2020. Data collected includes demographics, co-morbidities, envenomation characteristics, laboratory values, and case management. Pearson chi-square (χ^2), Fischer exact and Mann–Whitney-U tests were used to compare diabetic and non-diabetic participants.
Results: A total of 787 cases of patients aged over 18 with snakebite were reported to the NASBR registry from 17 states. Twenty-seven adults (3.4%) were diabetic. Diabetic participants were significantly older (median age 52 (IQR 44–60) versus median age 45 (IQR 31–58) in non-diabetics; $p = 0.016$) and diabetic patients had a higher prevalence of hypertension ($n = 18$ (67%) versus $n = 115$ (15%) in non-diabetics; $p < 0.001$). Rattlesnake envenomations were equally distributed among diabetic and non-diabetics ($n = 18$ (67%) versus $n = 523$ (69%), respectively, $p = 0.5$). Antivenom (AV) use, including number of vials, was not statistically significant between the two groups. Of non-diabetics $n = 545$ (71%), and $n = 21$ (78%) of diabetics received Crotalidae Polyvalent (ovine) Immune Fab. Forty-six (6%) non-diabetic patients and $n = 2$ (7%) of diabetic patients received Crotalidae Immune (equine) $F(ab')_2$ AV ($p = 0.48$). Hospital length of stay did not differ between the 2 groups ($p = 0.11$). Some systemic effects were more prevalent among diabetics (diarrhea: $n = 3$ (11%) versus n =13 (1.7%) in non-diabetics, $p = 0.015$; hypotension: $n = 5$ (19%) in diabetics versus $n = 43$ (6%) in non-diabetics, $p = 0.02$). Local envenomation effects (edema and ecchymoses), other systemic effects such as airway edema and the need for intubation, and neurotoxicity symptoms were not statistically different among the two groups. Furthermore, hematotoxicity was not different between the two groups (platelets <120 $p = 0.74$, fibrinogen 15, $p = 0.71$). Of the non-diabetic patients available for follow-up (up to 3 weeks after discharge), extremity swelling had "improved" ($n = 135$) or was no longer present ($n = 23$), while swelling was "extending" in 10 patients. Of diabetic patients available for follow up ($n = 17$), $n = 1$ had swelling that was "extending," $n = 6$ were showing improvement and $n = 3$ stated it was "unchanged." Three diabetic patients (9%) developed necrosis, where two required procedures (debridement, incision and drainage, and/or skin graft) compared to $n = 80$ (10.5%) non-diabetic patients who developed necrosis ($p = 0.55$). Sixty (8%) non-diabetic patients required procedures, where $n = 11$ required incision and drainage ($p = 1.0$).
Conclusions: A comparison of snakebite patients in the NASBR with and without diabetes revealed statistically significant differences in age and rates of occurrence of some systemic effects. Rates of local venom effects, hematologic and neurologic effects were similar between groups.

KEYWORDS Snake bites; diabetes; epidemiology

satti@uabmc.edu

73. Methemoglobinemia secondary to root vegetable ingestion

Conor Young[a], Jeanna Marraffa[b] and Vincent Calleo[a]
[a]SUNY Upstate Medical University, Syracuse, NY, USA; [b]Upstate NY Poison Center, Upstate Medical University, Syracuse, NY, USA

Background: Methemoglobinemia results when iron moieties in hemoglobin are oxidized from their ferrous (Fe^{2+}) to ferric (Fe^{3+}) states. Under normal circumstances, endogenous enzymatic pathways, including those involving cytochrome b5 reductase, mitigate methemoglobin accumulation by facilitating reduction back to the ferrous state. Methemoglobinemia may occur if enzymatic pathways are overwhelmed by oxidative stress. Nitrates and nitrites are known oxidant stressors; we present a case of methemoglobinemia likely caused by excessive root vegetable consumption, namely beets and carrots, which may have high in nitrate concentrations
Case report: A healthy 2-year-old female presented to the emergency department with fatigue, vomiting, and skin color change that her mother noted immediately prior to arrival. On arrival, she had perioral cyanosis as well as extremity and truncal pallor. Oxygen saturations were 85–87% on room air and did not improve with supplemental oxygenation. Chocolate brown blood was identified during blood draw. Methylene blue 1 mg/kg IV was given for methemoglobinemia with only moderate improvement of her color. Oxygen saturation remained 88% on supplemental oxygen prompting a second dose of methylene blue 1 mg/kg. She had a marked improvement in her oxygen saturations. Her initial methemoglobin level was too high to read but following the first dose of methylene blue, her methemoglobin level was 18%. Her initial lactate was elevated at 5.1 mmol/L. Following stabilization, the patient was admitted to the pediatric ICU for further workup and management. No known oxidant stressors, including moth balls, local anesthetics, antibiotics, supplements, or hotdogs, were identified after extensive history taking. The patient was monitored in the hospital overnight and had no recrudescence of symptoms. She was discharged the day after arrival with recommendations for primary care and genetic workup. The patient followed up with outpatient hematology who discovered the patient's diet consisted mainly of root vegetables, notably beets and carrots. Hematology felt this was an acquired methemoglobinemia secondary to root vegetable consumption and recommended removing these from her diet. Hematology recommended genetic consultation if symptoms return. The patient since had no recurrent symptoms and is doing well.
Discussion: We report a rarely encountered case of methemoglobinemia associated with root vegetable consumption, which were likely high in nitrates. Although root vegetables cannot be definitively determined as this patient's only oxidative stress, no other sources were identified and the symptoms have not returned since cessation of root vegetable consumption. This patient did not require repeat dosing of methylene blue which is consistent with root vegetable oxidative stress. Laboratory testing for methemoglobin may be limited in the presence of markedly elevated methemoglobin.
Conclusions: Oxidative stress secondary to excessive root vegetable consumption is a rare cause of acquired methemoglobinemia. Management includes methylene blue and removal of the stressor. Keeping a broad differential, including congenital and acquired causes, is essential when working up methemoglobinemia.

KEYWORDS Methemoglobinemia; vegetables; pediatrics

Youngcon@upstate.edu

74. Deviations from best practice: use of an equation based decision support tool for acute acetaminophen ingestion

HoanVu Nguyen[a], Christopher Hoyte[a] and Barry Rumack[b]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]School of Medicine, University of Colorado, Denver, CO, USA

Background: The Rumack-Matthew nomogram (RM nomogram) is the primary tool for risk stratifying and guiding treatment in acute acetaminophen (APAP) overdose. Some healthcare providers administer antidotal treatment without consultation with the RM nomogram or give treatment empirically. Administration of the antidote in this manner subjects patients to unnecessarily prolonged healthcare encounters, increased resource utilization, overall higher costs, and risk of complications. In this study, we determine the accuracy of a decision support tool developed for use in providing treatment recommendations for APAP overdose and determine rates of inappropriate antidote administration.
Methods: A retrospective chart review of all cases of APAP ingestions between March 1, 2020, and February 28, 2022, at an academic teaching hospital was performed. Inclusion criteria were chief complaint of overdose, drug problem, suicide attempt/ideation, or psychiatric evaluation and first serum [APAP] $\geq$ 4.6875 μg/mL. Exclusion criteria were non-acute ingestions, no recorded ingestion time, overdose with extended-release products, and "line-crossers." Outcome of interest was administration of N-acetylcysteine (NAC). The bedside provider's decision to administer NAC was compared to the output of a Microsoft Excel-based (Microsoft, WA, USA) tool that uses an equational representation of the RM nomogram treatment line: $f(t) = 150/(2\circ((t/4) - 1)$ for $4 \leq t \leq 24$, where "t" is difference in time from ingestion to lab draw in hours. This tool took the following inputs: time of ingestion, time of lab draw, and serum [APAP] in μg/mL, to provide treatment recommendations based on the comparison of the acquired serum [APAP] to the function output. When lab draws were <4 h or >24 h from time of ingestion, the tool would return a recommendation to redraw a lab in the appropriate time frame, or inability to use the RM nomogram.
Results: A total of 99 cases met criteria. Majority of patients were female ($n = 77$, 78%). Twenty-five patients (25%) received NAC. Disagreement between the provider and the decision support tool was noted in 21 cases (21%). In eight cases (8%), NAC was given when not recommended: six (6%) were cases where lab timing was <4 h (range 3.36–3.82 h); one (1%) was for "empiric NAC;" and one (1%) for an undocumented reason. For the other 13 disagreements (13%), a management decision was made with a lab <4 h after ingestion (range 3.07–3.95 h). There were no cases in which NAC was not given when otherwise recommended. In three cases (3%) additional labs were drawn despite an appropriate initial minimal risk concentration.
Conclusions: This study agrees with previously published data that there remains a trend toward NAC administration discrepant from generally accepted recommendations using the RM nomogram. Empiric use of NAC or inaccurate interpretation of guidelines may extend hospital stays unnecessarily, put patients at risk for adverse events, and add to costs without improving healthcare. Implementing an accessible tool such as the one here utilizing a precise representation of the RM nomogram can make determination of treatment criteria more accurately and quickly in the clinical setting, and these tools should be integrated into available electronic decision aids.

KEYWORDS Acetaminophen; decision support tool; quality of care

hoanvu.nguyen@rmpds.org

75. Cyanogenic glycoside plant calls increase to a regional poison center from 2010 to 2020

Faye Girardi and B. Zane Horowitz

Oregon-Alaska-Guam Poison Center, Portland, OR, USA

Background: Cyanogenic glycoside producing plants are ubiquitous. These plants range from common landscaping shrubs such as hydrangeas to fruit bearing trees such as apples, peaches, and apricots. Toxicity can occur after seed ingestion when these compounds are metabolized to hydrogen cyanide which impairs cellular respiration. A review of botanical calls to a regional poison center revealed that cyanogenic glycosides were the only category to show an increase over the past decade.
Methods: This was a retrospective review of all single substance human exposures to cyanogenic glycosides as identified by AAPCC category code (0088000). Data were extracted from the Toxicall database of a regional poison center from 2010 to 2020.
Results: There were a total of 11,944 cases of botanical exposures. The category cyanogenic glycosides represented 14.1% (1688) of calls during the study period. Gender distribution was equal. Exposures increased from a total of 9.7% of botanical calls in 2010, to 19.1% of calls in 2020. Symptoms were coded in 10% ($n = 172$), and of those 60% ($n = 104$) were followed to an outcome of minor, moderate, or death. In cases followed to outcome, there was 1 death, 11 cases with moderate effect, and 92 minor effect. There were 401 cases with a coded outcome of no effect. 78% of cases ($n = 1324$) involved pediatric patients, 81% of which were aged 0–5 years. There were no deaths in pediatric patients. For pediatric patients who experienced symptoms ($n = 100$), the majority were minor ($n = 67$) when followed to outcome. Overall 57% of cases involved common edible fruiting plants ($n = 959$): apple, apricots, cherries, loquat, nectarine, peaches, and plums. The species most commonly involved in cases where symptoms occurred was elderberry (31%) with symptoms predominantly gastrointestinal. Most patients had symptom resolution (71%) within 8 h after ingestion; 38% $\leq$ 2 h, 33% $\leq$ 8 h, 8% $\leq$ 24 h, 4% $\leq$ 3 days. One death occurred in a 68-year-old male from ingestion of 80 apricot kernels. Coded effects included hypotension, ventricular tachycardia/ventricular fibrillation, abdominal pain, AST/ALT >1000, jaundice, prolonged PT/INR, tachypnea, renal failure, acidosis, respiratory arrest, and asystole.
Conclusions: The last decade has shown increased number of poison center calls for cyanogenic plants. Although the outcome was benign in most patients, one death occurred after a larger intentional ingestion.

KEYWORDS Cyanogenic glycoside; plants; poison center

girardi@ohsu.edu

76. Characterizing "popper" toxicity and trends over the last decade reported to a regional poison center

Kayla Bourgeois[a], Cory Howard[b], Jeanna Marraffa[b] and William Eggleston[a]

[a]Binghamton University School of Pharmacy and Pharmaceutical Sciences, Binghamton, NY, USA; [b]SUNY Upstate Medical University, Syracuse, NY, USA

Background: Poppers typically contain nitrites and are used for euphoria and sexual enhancement. Despite recent Food and Drug Administration (FDA) warnings, they continue to be widely available and used. People experimenting with poppers can easily mistake the intended dose or route of administration due to the product formulation, lack of regulation, and limited knowledge of use. We sought to characterize the trends and toxicity associated with use of nitrites reported to a regional poison center over a 10-year period.
Methods: We conducted a retrospective review of intentional nitrite inhalation and ingestion exposures reported to our regional poison center between April 1, 2012 and March 30, 2022. Patients with coingestants, occupational or chemical substance exposures, presentation >24 h after the reported exposure, malicious exposures, or exposures involving a child <6 years of age were excluded. Data included age, gender, route, reason for ingestion, agent name if identified, peak methemoglobin level, management site, duration of toxicity, therapies and clinical effects. All data were manually extracted from case narratives by two researchers, and disagreements were reviewed by a third member of the research team. Descriptive statistics were used.
Results: 225 cases were identified, 18 ($n = 15$ males, $n = 3$ females) of which met inclusion criteria. Age was reported in 17 cases and the median age was 32 years(range 18–65). The most common route was inhalation/nasal(56%), followed by ingestion (33%), with a single exposure reported by both inhalation/nasal route and ingestion. Twice as many cases met criteria after 2017 (12 vs. 6 cases), 50% of which were in 2020–2022. A majority of these cases were coded as intentional abuse (67%). Cyanosis (39%), methemoglobinemia (28%), tachycardia (28%), respiratory depression (28%), and dyspnea (28%) were the most seen clinical effects and the most commonly provided therapies were oxygen (50%), fluids (33%) and methylene blue (33%). Every treated confirmed case of methemoglobinemia was from an ingestion, however, one case of inhalation/nasal exposures was treated with methylene blue but confirmatory levels of methemoglobin could not be obtained. Methemoglobin percentages ranged 10–56% in the 6 ingestions where levels were recorded. The dose of methylene blue ranged from 1 to 1.5 mg/kg. No case required redosing methylene blue. Of the ingestions, 57% ($n = 4$) were upgraded to a critical care level of management. Almost all cases (89%) were resolved within 24 h.
Conclusions: There is a need for increased public awareness and education on the severity of systemic effects from ingestion of nitrites versus the intended inhalation route. The number of nitrite exposures reported to our poison center appear to be increasing over the last decade and even more sharply over the last 2 years. Overall these cases seem to fully resolve within 24 h with supportive care and, if warranted, single-dose administration of methylene blue.

KEYWORDS Nitrite; methemoglobinemia; enhancement

bourgeka@upstate.edu

77. Direct oral anticoagulant ingestions: a review of the Toxicology Investigators Consortium Registry (ToxIC)

Edric Wong[a] and Tony Rianprakaisang[b]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]Department of Pharmacy, University of Kansas Med Center, Kansas City, KS, USA; [b]Department of Emergency Med, University of Kansas Med Center, Kansas City, KS, USA

Background: Direct oral anticoagulants (DOACs) have been present on the market, starting with dabigatran in 2010, a direct thrombin inhibitor. Newer agents have since been approved, including rivaroxaban, apixaban, and edoxaban, all of which are factor Xa inhibitors. Existing literature indicates ingestions or overdoses of DOACs may be managed conservatively with few cases requiring intervention. We sought to investigate outcomes of DOAC exposures within the Toxicology Investigators Consortium (ToxIC) Registry.
Methods: This is a retrospective review of single-agent exposures to DOACs in the ToxIC registry from 2010 through 2021.
Results: From 2010 through 2021 there were 45 total single-agent exposures to DOAC medications. Thirty-three cases were in adults, and 12 cases were pediatric. Of 33 adult cases, 24 involved exposure to factor Xa inhibitors and 9 involved dabigatran. Regarding adult Xa inhibitor exposures, 12 cases involved apixaban and 12 cases involved rivaroxaban. Six cases were of chronic use, and 18 cases involved acute or acute-on-chronic exposures. Factor replacement with prothrombin complex concentrate was given in two cases, both involving chronic therapeutic use. Unspecified anticoagulant reversal was used in two other cases: a 52-year-old male with acute suicidal ingestion of apixaban with hypotension and a 37-year-old female therapeutic use of rivaroxaban who experienced vaginal bleeding. In total, four cases in the dataset received some sort of pharmacologic reversal, with three out of four cases involving chronic therapeutic use. There were nine cases of dabigatran exposure in adults: three acute exposures and six chronic exposures. In total, three of nine patients required attempted reversal. One case involving therapeutic use in an 81-year-old male required reversal with vitamin K, which was given prior to the FDA approval of idarucizumab. In another dabigatran exposure, a 72-year-old male required the administration of packed red blood cells and fresh frozen plasma due to a gastrointestinal bleed. Lastly, an acute exposure to dabigatran in a 74-year-old female required idarucizumab reversal. Our data contained 12 pediatric(age </= 18) exposures, all with ingestions of factor Xa inhibitors. Nine cases were acute, and 3 were of unknown chronicity. No pediatric patients in our data set required anticoagulant reversal, decontamination, or enhanced elimination. Twelve suicidal ingestions were documented in the data, all involving factor Xa inhibitors with only one patient, mentioned above, requiring anticoagulant reversal. Of 45 cases, there was 1 death: a 74-year-old male with multisystem organ failure on chronic rivaroxaban unlikely to be related to its use. We analyzed 45 single-agent exposures to DOAC medications. With regard to Xa inhibitors, no pediatric cases required intervention, and only 1 out of 18 acute or acute on chronic cases in adults required pharmacologic intervention or reversal. Dabigatran cases were uncommon and conclusions about exposures to it are difficult to draw. Our data add to existing literature indicating that the majority of acute DOAC exposures do not require intervention.
Conclusions: The majority of acute exposures to DOAC agents do not require intervention. This study adds to existing data suggesting most acute ingestions do well.

KEYWORDS Anticoagulant; overdose; acute

ewong@kumc.edu

78. Alerting healthcare providers during a cluster of coagulopathy associated with synthetic cannabinoid use

Jemima Douge, Justin Arnold, Alexandra Funk and Stefan Weekes

Florida Poison Information Center – Tampa, Tampa, FL, USA

Background: On December 4, 2021, the Poison Center identified an anomaly of 13 patients admitted to local hospitals with the acute onset of severe bleeding and bruising with no prior

bleeding history. Without knowing the extent and actual cause of this new cluster of coagulopathy, the Poison Center aimed to alert healthcare professionals in the counties served.
Methods: Within the first 12 h after identifying the cluster, the poison center sent alerts to all emergency departments in the 16-county region using the center's emergency alert system, Vesta Blast Fax. This system allowed the center to provide timely updates around the clock as the outbreak unfolded. Initially, the alert included only basic known information such presenting signs and symptoms – epistaxis, hematemesis, hematuria, hemoptysis, and hematochezia. Alerts were sent at predetermined times intervals (every 12 h) to ensure healthcare providers working different shifts received this critical information. The center also sent direct faxes targeting different hospital units like ICU and other healthcare facilities in the region. To ensure that more providers became aware of the outbreak, the center also utilized direct emails, news, and social media. As the outbreak progressed and Brodifacoum was identified as the culprit contaminant, the center utilized the same method to provide updated and additional information such as testing, treatment recommendations, and discharge instructions.
Results: Through our efforts, healthcare professionals in the region were informed about the potential risk of bleeding associated with Brodifacoum-contaminated synthetic cannabinoids use. Having included the abnormal International Normalized Ratio (INR) as a potential indicator of suspected cases was essential in identifying additional patients. Providers were also instructed to inquire about synthetic cannabinoid use should they have patients with these presenting symptoms. Part of the alert also encouraged clinicians to report all potential cases to the poison center to help monitor the extent of the outbreak. Over 40 patients were identified within 2 weeks of initial alert.
Conclusions: Providing help through the Poison Hotline is what most people think of when it comes to poison center services. The unique role the center played in alerting and constantly updating healthcare providers during this outbreak highlighted the multifaceted approach to the services provided by poison centers. Beyond providing treatment recommendations for the affected patients, the center closely monitored this outbreak and kept healthcare providers informed through timely alerts and updates.

KEYWORDS Emergency alert-healthcare providers; coagulopathy outbreak; synthetic cannabinoid use

jdesir@tgh.org

79. Green pit viper envenomations in Bangkok: a comparison of follow-up compliance and clinical outcomes in older and younger adults

Rittirak Othong[a], Thanaphat Eurcherdkul[a] and Prasit Chantawatcharakorn[b]

[a]Department of Emergency Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand; [b]Department of Emergency Medicine, Taksin Hospital, Bangkok, Thailand

Objectives: (1) To compare the follow-up compliance between the older (≥60 years old) and the younger (15–59 years old) adult patients who were bitten by green-pit viper (GPV) snakes. (2) To compare elapsed time from the bite to the emergency department (ED) visit. (3) To compare clinical and treatment outcomes.
Methods: This was a two-site retrospective cohort study. We searched the hospital electronic medical databases from two hospitals in Bangkok using the ICD10 (codes X20, X27, X29) between January 2011 and December 2021. Patients aged 15 and above were eligible for this study if they had a history of animal bites and had at least two VCT and/or platelet count results. We excluded cases with other animal bites, patients with insufficient data, and those with missing medical records.
Results: In total, 760 cases were included for data analysis, 205 cases were 60 years old or older (27.0%). The median ages in the younger and older groups were 40 (26–51) and 68 (64–75) years, respectively. The median elapsed times from bite to the ED were 47 (30–118) VS 69 (35–150) minutes in the younger and the older ones, p-value =0.001. Overall, 91.3% of all cases of the GPV bite were managed as out-patient, and were eligible for follow-up appointment, only 8.8% were admitted. The rate of complete out-patient follow-up at 72 ± 12 h in the older patients was higher (43.2%) than that in the younger adult patients (32.4%) significantly(p-value =0.01). For the clinical and treatment outcomes, the rates of coagulopathy, antivenom administration, and hospital admission were not statistically different between both groups.
Conclusions: The older adults took more time to reach the ED after the GPV bite, but had a higher rate of complete follow up at 72 ± 12 h. Even though the older patients had more underlying diseases, they had favorable outcomes and that were similar to those outcomes in the younger ones.

KEYWORDS Elderly; compliance; snakebite

toppoter@yahoo.com

80. Assessment of time delays of Intravenous N-acetylcysteine doses for the treatment of presumed acetaminophen toxicity in a multicenter health-system

Kevin Mercer[a], Raina Abraham[b], Mary Billington[c], Joshua Feinstein[d] and Mark Winter[e]

[a]Memorial Hermann Memorial City Medical Center, Houston, TX, USA; [b]Texas Southern University College of Pharmacy and Health Sciences, Houston, TX, USA; [c]UTHealth Houston McGovern Medical School, Houston, TX, USA; [d]Memorial Hermann Health System, Houston, TX, USA; [e]Southeast Texas Poison Center, Galveston, TX, USA

Background: N-acetylcysteine (NAC) is administered intravenously (IV) in various dosing schemes for acetaminophen (APAP) toxicity. Perhaps the most common dosing scheme is the Food and Drug Administration (FDA) approved regimen with three different volume doses with three different concentrations over 21 h. There is sufficient literature regarding improved patient outcomes with initiation of NAC for acute APAP toxicity within 8 h of ingestion. However, there is little data describing the impacts on patient outcomes associated with delays between each dose in the 21-h regimen. The objective of this study is to quantify delays between doses and characterize impacts on patient outcomes for patients receiving NAC for APAP toxicity in a multicenter health-system.
Methods: This is a multicenter, retrospective, observational cohort study examining patients with NAC orders for presumed acetaminophen toxicity from January 2020 to December 2021. A dataset containing all doses of IV NAC ordered within the study timeframe was compiled from pharmacy surveillance software. Patients were excluded from analysis if they received NAC for indications other than presumed APAP toxicity or if only one dose of NAC was administered. Doses beyond the standard third dose were not assessed. Patients receiving NAC in the incorrect order were excluded from the time analysis. For doses 2 and 3 of

the 21-h regimen, 1 h and 5 h were added to the original order time, respectively, to obtain the originally intended administration time. Dose delays were calculated by subtracting the dose administration time charted by the nurse from the originally intended administration time from the provider. A *t*-test compared time delays of doses 2 and 3 with the time delay of dose 1.

Results: A total of 797 patients received orders for intravenous NAC among 11 hospital sites within the health-system in the two-year study period. Of the 797 total patients, 335 (40.7%) patients met criteria for analysis. Of the 335 included patients, 109 (32.5%) were male and 96 (28.7%) were less than or equal to 18 years of age. Of the 797 total patients, 324 (40.7%) were included in the time analysis and 11 (1.4%) patients received dose administrations in the incorrect order and were excluded from time analysis. The median delay in minutes (IQR) for the first, second, and third doses of NAC for APAP toxicity among the health-system were 63 (46, 91), 98.5 (68, 146.7) and 157 (109.5, 232), respectively. There were statistically significant increases in delay times between doses 1 and 2 ($p = 0.0001$) and doses 1 and 3 ($p = 0.0001$).

Conclusions: Timeliness of NAC administration is crucial to patient outcomes. When IV NAC can be administered to patients within 8 h of ingestion, patient outcomes are improved. However, there is little data describing the impacts on patient outcomes associated with delays in dose administration in the FDA-approved three dose 21-h regimen. This study quantified a statistically significant increase in inter-treatment dose delays of NAC administered for presumed APAP toxicity in patients presenting to eleven hospitals within a health-system over a two-year study period. Future directions of this study will examine the impacts on patient outcomes associated with each dose delay, which may demonstrate a need for adjusting NAC administration strategies to a one dose and concentration administration

KEYWORDS N-acetylcysteine; delay; acetaminophen

kevin.mercer@ymail.com

81. An assessment of the reliability of stated quantity in acute acetaminophen overdoses reported to a regional poison center

Nicholas Husak, James Leonard and Angela Lam
Maryland Poison Center, Baltimore, MD, USA

Background: Acetaminophen is one of the most common acute intentional ingestions reported to Poison Centers in the US (US). While the Rumack-Matthew nomogram is the gold standard for assessing acute acetaminophen overdoses, researchers in countries outside the US have evaluated the reliability of stated dose as a predictor for the need for N-acetylcysteine. There is limited data for the use of stated doses in a US population. The intent of this study is to identify the proportion of patients who overdose on acetaminophen that accurately report their dose and time of ingestion.

Methods: This is a retrospective study from a single regional poison center. We screened single-substance acetaminophen cases seen in a healthcare facility from January 1, 2019 to December 31, 2021. For the primary outcome, we included cases where time of ingestion, weight, dose of acetaminophen, and acetaminophen concentration within 4 and 24 h after the time of ingestion were recorded. The predicted acetaminophen concentration was calculated with: (Dose*F*Ka)/(Vd*[Ka-Ke])*(e∘-Ke(t) − e∘-Ka(t)) Where F = 0.89, Ka =1.4, Ke =0.17325, t = time after ingestion; if a patient received activated charcoal, the F was reduced to 0.78. We evaluated the proportion of patients with observed acetaminophen concentrations within ±10% of the predicted concentration and those with an observed concentration ±10 mcg/mL above or below the predicted. We also evaluated those with reported massive ingestions (40 g or more) and the reliability of this report. An acetaminophen concentration recorded as "less than" a value was coded as 1 for statistical analysis. Median and interquartile range (IQR) are presented.

Results: We screened 1092 cases over the 3-year period. The three most common reasons for exclusion were chronic ingestion (252), no dose stated (125), and no time of ingestion (109). Additionally, 214 cases did not have a weight documented and were used in the exploratory analysis. Complete data were available for 288 patients. Median age was 17 years (IQR: 14, 22), they were mostly female (228/288), and median weight was 68.3 kg. Activated charcoal was administered in 126/288 cases. Median variation between observed and predicted was 19.4% (IQR: −35.6%, 76.1%; range: −100% to 6018%). Median difference was 2.7 mcg/mL (IQR: −26.8, 35.2; range: −625.6, 836.0). In the primary population, 23/288 (8.0%) had an observed serum concentration within ±10% of the predicted serum concentration and 55/288 (19.1%) had an observed ±10 mcg/mL above or below predicted. The observed concentration was greater than accepted predicted ±10% range in 154/288 (53.4%) and less than predicted in 111/288 (38.5%). Twenty-six cases involved massive ingestions. Of these 26 cases, none had an observed concentration within ±10% of the predicted concentration. Observed concentrations were higher than predicted in 4/26; observed concentrations were lower than predicted in 22/26. Twenty-four of twenty-six received activated charcoal. Accounting for charcoal, 2/24 were within ±10%, 13/24 were below and 5/24 were above.

Conclusions: Stated dose of acetaminophen in acute overdose accurately predicted a concentration in 8% of cases. Researchers should explore alternatives to stated history when approaching assessment of dose.

KEYWORDS Acetaminophen; toxicokinetics; prediction

nhusak@rx.umaryland.edu

82. Difficulty weaning intravenous dextrose following high dose insulin therapy treated successfully with octreotide

Ryan Fuchs[a], Stacey Bangh[b] and Jon Cole[b]
[a]Healthpartners Regions Hospital, St. Paul, MN, USA; [b]Minnesota Poison Control System, Minneapolis, MN, USA

Background: High dose insulin (HDI) has become a standard therapy for both beta-blocker and calcium channel blocker related poisonings. Typical HDI infusion rates range from 1 to 10 U/kg/h, with median duration of approximately 2 days. Hypoglycemic events are common, ranging from 50% to 75% and high dextrose infusions are typically required to avoid iatrogenic events. After discontinuation of HDI, supplemental dextrose is typically needed due to persistent supraphysiologic exogenous insulin concentrations. Dextrose infusions are often weaned based on targeted serum glucose concentrations, with a margin of safety to avoid hypoglycemic events. However, this margin of safety may prolong dextrose infusions due to simultaneous exaggerated endogenous insulin secretion in response to elevated serum glucose concentrations. We report a case of labetalol poisoning treated with HDI, with dextrose infusion weaning facilitated by octreotide administration.

Case report: A 60-year-old woman was admitted to the intensive care unit following a polysubstance ingestion including labetalol, hydrochlorothiazide, and valsartan. On presentation, she was

awake and talking with BP 65/31 mmHg and HR 40 beats/min. She had persistent hypotension and bradycardia despite 3 L IV fluids, glucagon and norepinephrine. HDI therapy was started at 1 U/Kg IV bolus followed by a 1 U/kg/h IV infusion. She was started on 50% dextrose infusion to maintain serum glucose >110 mg/dL. HDI was uptitrated to 10 U/kg/h for approximately 6 h without significant hemodynamic improvement, and was thus down titrated back to 1 U/kg/h due to concern HDI potentiating vasoplegia. After approximately 30 h, hemodynamic status improved and HDI was discontinued. Dextrose infusion continued for 6 days post cessation of HDI therapy, with challenges weaning due to both relative and absolute hypoglycemia associated with down titration of dextrose. Given its modest cost and extremely safe side effect profile, octreotide was considered to mitigate any contribution of endogenous insulin secretion to the difficulty in dextrose weaning. On hospital day 7, the patient received 50 mcg of octreotide for 2 doses 6 h apart, the dextrose was rapidly turned off, the patient had no further hypoglycemic episodes and she was able to be discharged on hospital day 8.

Discussion: Persistent dextrose infusions following HDI therapy are common, safe weaning of which is dependent on pharmacokinetic characteristics of exogenous insulin and exaggerated endogenous secretion in response to IV dextrose administration. While elimination characteristics of HDI-administered insulin are limited to case reports, described levels typically fall to physiologic range within 24–48 h after discontinuation. Supraphysiologic blood glucose concentration goals and lack of appetite contribute to challenges with prompt weaning of dextrose infusions. Octreotide is a safe, effective medication that can limit endogenous insulin secretion. After allowing for appropriate time for elimination of exogenous insulin, octreotide may be considered to facilitate more rapid cessation of dextrose infusions and critical care.

Conclusions: In cases of recurrent hypoglycemia following cessation of HDI, octreotide may be considered to facilitate weaning of IV dextrose and earlier deescalation of critical care.

KEYWORDS High dose insulin; octreotide; beta-antagonist overdose

ryan.fuchs@hcmed.org

83. Accuracy of cannabinoid screening and automatic confirmatory testing amongst patients at a pediatric hospital: an observational study

Christopher Watson[a], Nazmin Bithi[b], Gwendolyn McMillin[b] and Michele Burns[a]

[a]Boston Children's Hospital, Boston, MA, USA; [b]University of Utah School of Medicine, Salt Lake City, UT, USA

Background: Tetrahydrocannabinol (THC) testing in pediatric patients is often via in-hospital urine immunoassay (UIA) screening for metabolite 11-nor-9-carboxy-delta-9-THC (THC-COOH) with reflex confirmatory liquid chromatography-mass spectrometry (LC-MS) testing for THC-COOH to ensure no false-positive THC UIA results. Due to cross-reactivity with other THC metabolites, a UIA may result positive for THC-COOH despite low THC-COOH concentrations. Conversely, LC-MS testing of the same sample may result as negative due to THC-COOH that is only present in concentrations below the reporting threshold. Given its ubiquitous nature and evolving legality, most children and adolescents with positive UIAs have a high probability for exposure to THC, limiting the utility of confirmatory testing. That said, confirmatory testing may be valuable in the setting of possible abuse or neglect, or in substance use monitoring for high-risk patients. In these cases, the presence of any detectable THC-COOH, even in trace amounts below the LC-MS reporting threshold, is relevant. Amongst patients at a pediatric hospital, we aim to assess the false-positive rate of UIAs and false negative rate of LC-MS reports compared against raw LC-MS data identifying THC-COOH at the lowest detectable limit.

Methods: Retrospective review of all patients with a positive THC-COOH UIA collected in any clinical environment (inpatient, outpatient, emergency department – ED) at a pediatric hospital between November 18, 2019 and May 31, 2021. UIA testing was performed via Roche KIMS (kinetic interaction of microparticles in solution) immunoassay for THC-COOH (cutoff 25 ng/mL). Per hospital policy, positive UIAs are automatically sent to a commercial laboratory for confirmatory LC-MS testing for THC-COOH, which has a reportable cutoff of 15 ng/mL. For this study, the raw LC-MS data for all samples with a positive UIA and negative LC-MS report were retrospectively analyzed to identify the presence of THC-COOH down to the limit of detection (5 ng/mL). Test characteristics were calculated for THC-COOH UIAs and LC-MS reports compared against the gold standard of the raw LC-MS data.

Results: There were 976 positive UIA samples for THC-COOH during the study period. 38 were from those <10 years old, 683 were from those aged 10–17 years old, and 254 were from those ≥18 years old. 54.30% were from females and 76.02% were obtained in the ED. Amongst all positive UIAs, 99/976 (10.14%) had negative LC-MS reports. When assessed against the LC-MS cutoff of 5 ng/mL, the false negative rate of LC-MS reports was 80/99 (80.81%) and the false-positive UIA rate decreased from 99/976 to 19/976 (1.95%). Amongst those <10 years old, 7/38 (18.4%) had negative LC-MS reports. The false negative rate of LC-MS reports was 4/7 (57.1%). The false-positive UIA rate decreased from 7/38 to 3/38 (7.9%). Amongst those 10–17 years old, 73/683 (10.69%) had negative LC-MS reports. The false negative rate of LC-MS reports was 61/73 (83.56%). The false-positive UIA rate decreased from 73/683 to 12/683 (1.76%).

Conclusions: False-positive UIAs for THC-COOH were rare, challenging the utility of reflex confirmatory testing. The UIA false-positive rate was dependent on the cutoff threshold of the confirmatory LC-MS report. Most patients with positive UIAs and negative LC-MS reports in fact had detectable THC-COOH in their urine. Negative LC-MS testing at a cutoff of 15 ng/mL cannot exclude the presence of THC-COOH in a patient's urine.

KEYWORDS Cannabinoid; drug testing; resource utilization

cjameswatson54@gmail.com

84. Severe outcomes following pediatric cannabis intoxications: a prospective cohort study of an international toxicology surveillance registry

Neta Cohen[a], Mathew Mathew[a], Jeffrey Brent[b], Paul Wax[c], Adrienne Davis[a], Cherie Obilom[d], Michele Burns[e], Joshua Canning[f], Kevin Baumgartner[g] and Yaron Finkelstein[a]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]The Hospital for Sick Children, Toronto, Ontario, Canada; [b]School of Medicine, University of Colorado, Denver, CO, USA; [c]University of Texas Southwestern, Paradise Valley, AZ, USA; [d]University of Texas Southwestern Medical Center, Dallas, TX, USA; [e]Boston Children's Hospital/Harvard Med Toxicology, Belmont, MA,

USA; [f]Banner – University Medical Center, Phoenix, AZ, USA; [g]Washington University School of Medicine in St. Louis, St. Louis, MO, USA

Background: An increasing number of states and jurisdictions have legalized or decriminalized recreational cannabis for adult use. The subsequent availability and marketing of recreational cannabis following legalization has led to a parallel increase in rates and severity of pediatric intoxications. We explore predictors of severe outcomes (i.e., intensive care unit [ICU] admission or in-hospital death) in children and adolescents who presented to the Emergency Department (ED) with cannabis intoxication.
Methods: In this prospective cohort study, we collected data on all pediatric patients (0–18 years) who presented with cannabis intoxication from August 2017 through June 2020 to participating sites in the Toxicology Investigators Consortium (ToxIC), a multi-center registry of intoxicated patients who received a bedside consultation by a medical toxicologist. In cases that involved polypharmacy exposure, patients were included if the medical toxicology team determined that cannabis was a significant contributing agent. We collected relevant demographic, clinical, management, disposition, and outcome data. We conducted a multivariable logistic regression analysis to explore predictors of severe outcome. The primary outcome was a composite severe outcome endpoint, defined as ICU admission or in-hospital death. Covariates included sociodemographic and exposure characteristics.
Results: One hundred and thirty-eight pediatric patients presented to a participating ED with cannabis intoxication and were consulted at the bedside by medical toxicologists. There were 75 males (54%), and the median age was 14.0 years (IQR 3.7–16.0). Among all patients, 52 (38%) were admitted to ICU and/or died during hospital stay; the remaining 86 did not meet these criteria. In the multivariable logistic regression model, polypharmacy ingestion (aOR =10.5, 95% CI: 3.2–34.3; $p < 0.001$) and cannabis edibles ingestion (aOR =4.1, 95% CI: 1.6–10.7; $p = 0.003$) were independent predictors of severe outcome.
Conclusions: Pediatric patients who presented to ED with cannabis intoxication and also had polypharmacy intoxication or have ingested cannabis edibles had 10.5- and 4.1- higher odds of severe outcome, respectively, than those without these characteristics. Prevention efforts should target these risk factors to mitigate poor outcomes in pediatric patients with cannabis intoxications.

KEYWORDS Cannabis; pediatric; outcome

netarab81@gmail.com

85. Associations between the COVID-19 pandemic and exposures to bleach, peroxide, disinfectants, antimalarials and ivermectin reported to a poison control system

Raeann Salonga[a], Alice Ghai[a], Emily Sabour[a], Raymond Ho[b] and Dorie Apollonio[a]

[a]University of California San Francisco, San Francisco, CA, USA; [b]CA Poison Control System/University of California San Francisco, San Francisco, CA, USA

Background: The COVID-19 global pandemic led to widespread fear of infection, and many people responded by expanding their use of cleaning products despite advice from public health authorities, trying unproven prevention and treatment strategies. Although popular media has occasionally reported on dangerous COVID-19 home interventions, existing research studies of exposures have largely been point-in-time analyses with little or no follow-up to assess whether trends have persisted, and most were conducted outside the US.
Methods: This retrospective medical records review study analyzed all suspected toxicity cases of bleach, peroxide, disinfectants, the antimalarials hydroxychloroquine (HCQ) and chloroquine (CQ), and ivermectin reported to a single US statewide Poison Control System from 2015 to 2021 using interrupted time series analyses (ITSA).
Results: There was a significant increase in exposures related to cleaning products (bleach, hydrogen peroxide, and disinfectants) and ivermectin during the COVID-19 pandemic. There were 75,714 exposures reported to this statewide Poison Control System from 2015 to 2021, of which 60,474 related to the use of bleach, peroxide, disinfectants, antimalarials, and ivermectin. Prior to March 2020, exposures to household cleaning products were declining over time ($p = 0.004$, coeff $= -1.71$). There was an immediate, significant increase of 466 exposures coinciding with the start of the COVID-19 pandemic in March 2020, from the baseline level of 707 cases reported in the month of January 2015 ($p < 0.001$, coeff =466.6). Exposures to cleaning products then significantly decreased by 25 exposures per month following the first months of the pandemic ($p < 0.001$, coeff $= -25.1$). Medications showed different patterns over time. Ivermectin exposures prior to December 2020 were initially stable, then increased significantly by over 2 exposures per month through December 2021 ($p = 0.007$, coeff =2.05). Reported exposures to antimalarials did not change significantly before or during the COVID-19 pandemic.
Conclusions: After the COVID-19 pandemic, exposures to household cleaning products increased immediately and then quickly declined to pre-pandemic levels. Intentional cleaning product exposures increased slightly in March 2020, but the majority of exposures were unintentional, and likely associated with suggestions to increase hygiene measures at the beginning of the pandemic. In contrast, exposures for ivermectin increased steadily from December 2020 to December 2021. Antimalarial exposures remained stable before and during the pandemic. The onset of the COVID-19 pandemic was followed by significant increases in toxic exposures including bleach, peroxide, disinfectants, and ivermectin, but the patterns over time were different for each product type. These observations suggest that while some dangerous home prevention and treatment efforts resolve over time, further public health interventions may be needed to reduce public health impacts related to attempts to self-treat with ivermectin. Health care providers and the general public should be made aware of the risks and dangers of products and medications in order to reduce adverse events and serious outcomes.

KEYWORDS COVID-19; cleaning products; ivermectin

raeann.salonga@ucsf.edu

86. Acute pediatric fentanyl toxicity from body packing in a 14-month-old

James Whitledge[a], Christopher Watson[a], Michael Simpson[b] and Michele Burns[c]

[a]Boston Children's Hospital, Boston, MA, USA; [b]Boston Children's Hospital, Brookline, MA, USA; [c]Boston Children's Hospital/Harvard Med Toxicology, Belmont, MA, USA

Background: Body packing to conceal illicit drugs is a well-known phenomenon in adults, but is rarely reported in children. Heroin and oxycodone body packing in patients as young as 6 years old have been reported, however fentanyl body packing in a toddler has not been previously described.
Case report: A 14-month-old male presented to a community emergency department (ED) with obtundation, miotic pupils, and

a respiratory rate of four. Two milligrams of intranasal naloxone were administered with rapid improvement in respiratory and mental status upon ED arrival (hour zero). A 1 mg rescue dose was required for recrudescence of opioid toxidrome at hour one. The patient was transported by ambulance to a pediatric tertiary care hospital; at hour two while en route, recurrent somnolence necessitated an additional one milligram naloxone bolus and infusion. The patient was admitted to the intensive care unit and by the following morning (hour 17, hospital day two), the naloxone infusion was discontinued without further episodes of somnolence or bradypnea. Abdominal x-ray showed no foreign body. In the evening of hospital day two (hour 24), the patient passed multiple clumps of a white powdery substance in his stool, some wrapped in plastic. Sixteen foreign bodies in total were passed, which were collected as evidence by law enforcement; testing results are pending. Abdominal ultrasound showed no evidence of intraluminal gastric foreign body. Polyethylene glycol was administered for gastrointestinal decontamination. The gastroenterology service was consulted and could not identify a possible organic cause of the stool contents. The mother reported at baseline the patient consumed no meaningful quantity of any solid food. Additional clumps of white powder were passed on hospital day 3. Urine quantitative fentanyl and norfentanyl concentrations on hospital day one were 53 ng/mL and 203.6 ng/mL, respectively; 12.1 ng/mL and 111.8 ng/mL on hospital day two; and undetectable and 3.3 ng/mL on hospital day four (mean urine fentanyl and norfentanyl concentrations of chronic pain patients using 25 mcg/h fentanyl patches are 47 ng/mL for fentanyl, 175 ng/mL for norfentanyl). The patient never developed recurrent toxicity and was discharged on hospital day 6 following safe disposition planning by social work and child protective services.

Discussion: This case highlights the need to remain vigilant for body packing in even the youngest of children who present with findings consistent with opioid toxicity or other drug-induced toxidrome. It is highly unlikely that this 14-month-old could independently ingest 16 bags containing fentanyl, suggesting that they may have been inserted rectally. Healthcare providers should be aware of this as a possible exposure route. Fentanyl and its analogs may require higher naloxone reversal doses than heroin or oxycodone, which have previously been reported in pediatric body packers. Fentanyl and its metabolite norfentanyl may be present in urine for multiple days following resolution of clinical toxicity in pediatric patients, which may have forensic relevance.

Conclusions: Body packing may occur even in toddlers and can present with significant toxicity. Urine fentanyl and norfentanyl levels may remain detectable days after resolution of clinical symptoms.

KEYWORDS Body packing; fentanyl; toddler

james.whitledge@childrens.harvard.edu

87. "Baby" aspirin

Nathan Kunzler, Abby J. Montague, Kirk Hughes and Jon Cole

Minnesota Poison Control System, Minneapolis, MN, USA

Background: Salicylism is a common poisoning that has been with us since antiquity. While the clinical course, complications, and treatments are well defined in most of the population, experience in infants is limited. This is likely due to limited exploratory opportunities, lack of self-harm motivation, and the risk of Reye' syndrome prohibiting therapeutic use in this population. We report here a case of significant salicylism in an infant.

Case report: The regional poison center was contacted in the case of an 8-month-old found in their crib with chewable aspirin residue on the mouth after an older sibling had dumped a bottle containing the same into the crib. The time of exposure was unknown. The initial salicylate concentration [ASA] resulted at 35 mg/dL. Activated charcoal was not given at this time. The regional poison center recommended initiation of isotonic sodium bicarbonate dosed at 1 mEq/kg as an initial bolus followed by an infusion at 1.5× the maintenance rate. Repeat [ASA] obtained at the originating facility resulted in 50.3 mg/dL. The patient was then transferred to a tertiary care center. The next [ASA] resulted at 80 mg/dL 5 h into the clinical course of this patient. At this point, a nasogastric tube was placed and activated charcoal administered. Repeat [ASA] was 74 mg/dL 2 h later. Core temperature was then measured at 100.7 degrees F. Two hours later serial [ASA] resulted at 59 mg/dL and core temperature was noted to be decreasing. Subsequent [ASA] measurements were 52 mg/dL, 35 mg/dL, and 26mg/dL. Following these measurements the bicarbonate infusion was discontinued and the patient was noted to be at their baseline.

Discussion: In this case, we assisted in the management of an infant with an accidental exposure to aspirin. The tablets were later confirmed to contain 325 mg each. Based on the weight of our patient, as few as 4.5 tablets could lead to the concentrations measured in this case. This highlights the potential danger of accidental exposure to salicylate containing products in children. This case is notable due to the low numbers of significant salicylate poisoning in patients this age. Infants are more prone to electrolyte disturbances due to immature renal function. This case demonstrates the safety, at least in this instance, of using weight-based isotonic bicarbonate to achieve urine alkalization. This is especially important since few hospitals are capable of initiating hemodialysis in an infant. Ultimately, this patient was managed successfully using standard therapies with weight-based doses of medication.

Conclusions: Salicylism in infants may be possible even in relatively low volume accidental exposures. In this case, standard therapeutic strategies seemed to offer appropriate care for our patient.

KEYWORDS Aspirin; hemodialysis; infant

nathan.m.kunzler@gmail.com

88. Fatal hyperammonemia in a pediatric patient taking deferasirox (Jadenu®): a case report

Christopher Wilkosz[a], Mark Neavyn[a], Joshua Swenson[b], Ian Wells[c] and Karen Simone[a]

[a]Northern New England Poison Center, Portland, ME, USA; [b]Maine Medical Center, Portland, ME, USA; [c]Lennox Hill Hospital, New York City, NY, USA

Background: Deferasirox (DFX) is an oral chelator used to treat chronic iron overload in patients with transfusion-dependent diseases such as β-thalassemia. While DFX is generally well-tolerated, post-marketing surveillance has demonstrated a risk for drug-induced liver injury and hyperammonemia. This case report highlights the need for health care providers to be aware of these risks in patients taking DFX.

Case report: A 16 year old female with transfusion-dependent β-thalassemia treated with DFX for 5 years presented to the emergency department for 12 h of worsening abdominal pain, nausea, and vomiting. Routine outpatient lab work drawn on the morning of the presentation showed a serum ferritin level of 188 ng/mL. In the ED, laboratory analysis was notable for a total bilirubin of 11.0 mg/dL, aPTT/INR of 38/1.7, a lactate of 5.7, and AST/ALT of 25/26. Comprehensive evaluation for viral etiologies was negative, abdominal ultrasound showed no hepatic

abnormalities, and an antinuclear antibody test was negative. While in the ED, she developed acute onset agitation, hypotension, tachycardia, and muscle rigidity. Toxicology was initially consulted with concern for neuroleptic malignant syndrome (NMS) which was ruled out. She was transferred to an intensive care unit, where she rapidly became unresponsive with labored breathing requiring intubation for airway protection. Neurologic exam was significant for disconjugate gaze, absent withdrawal from pain, and extensor plantar responses present. Her ammonia level was profoundly elevated at 1222 mcg/dL. Given her neurologic deterioration, hypertonic saline and mannitol were administered for presumed cerebral edema, and dialysis was initiated for her hyperammonemia. Despite treatment, at around 16 h after the presentation to the ED, her pupils became fixed and dilated. Subsequent neurological evaluation was consistent with brain death. Genetics was consulted, but no underlying metabolic conditions were identified via exome sequencing. The patient passed away 64 h after the presentation to the ED.

Discussion: Acute hyperammonemia is a neurologic emergency leading to glutamate-induced neuroexcitation and toxicity terminating in irrecoverable cerebral edema. Clinically, as seen in this case, hyperammonemia can resemble other toxicological pathologies such as NMS or serotonin syndrome, which is a consult frequently sought at poison centers. The mechanism of DFX-induced liver toxicity is not well understood, with case reports postulating interference with urea cycle functioning, free drug accumulation in the setting of chelation with low iron stores, and drug metabolizing enzyme polymorphisms. DFX's prescribing information suggests interrupting chelation therapy when serum ferritin falls below 500 ng/mL; increased free drug concentrations could have been a contributing factor in the development of toxicity.

Conclusions: This report emphasizes the consideration of acute hyperammonemia as a cause for neurological effects consistent with serotonin syndrome and NMS. Given the absence of infectious, metabolic, or autoimmune etiology, we suggest that DFX was the cause of the patient's liver dysfunction and hyperammonemia. The FDA's Pediatric Advisory Committee is currently evaluating similar cases of hyperammonemia in pediatric patients taking DFX.

KEYWORDS Pediatric; deferasirox; hyperammonemia

CWilkosz@mmc.org

89. Etiology of methemoglobinemia: an NPDS observational study

Andrew Chambers[a], Emily Kershner[a], Natasha Tobarran[a], Andrew Alberter[a], Kirk Cumpston[a], Rutherfoord Rose[b] and Brandon Wills[a]

[a]VCU Health, Richmond, VA, USA; [b]Virginia Poison Center, Richmond, VA, USA

Background: There are few data that distinguish rare from common causes of methemoglobinemia (MetHb). Classic teachings often cite aniline dye or chlorates as frequent causes. Recognition of the substances most commonly implicated in causing MetHb can inform clinicians, impact treatment decisions, and influence prevention discussions. The National Poison Data System (NPDS) added MetHb as a clinical effect in 2019. The aim of this investigation was to identify the most common etiologic substances implicated in modern day MetHb using data reported to NPDS.

Methods: This was a retrospective cross-sectional study using electronic data from NPDS evaluating drugs and chemicals coded with MetHb as a clinical effect from January 1, 2019 to January 31, 2022. Inclusion criteria included all cases with MetHb coded as a clinical effect, treated at a healthcare facility, and outcome coded $\geq$ moderate effect. Exclusion criteria were information and non-human cases, cases coded as "unrelated effect, the exposure was probably not responsible for the effect(s)," or outcome scored as "not followed, minimal clinical effects possible (no more than minor effect possible)." Cases were also excluded if the product was unknown or believed to not cause MetHb. Unknown substances were defined as unable to identify product based on generic category. The primary outcome was to identify substances associated with MetHb, and further identify substances associated with methylene blue administration or fatal outcome.

Results: There were 809 reported cases in which MetHb was coded as a clinical outcome and after 129 excluding cases, 680 cases were evaluated. The average patient age was 41 (SD 21) years with 85% 18 years or older; 49% were female. Overall, the five most common substances associated with MetHb were: dapsone, nitrate/nitrite, unknown, phenazopyridine, and benzocaine and those who received methylene blue are listed in. Of the fatal cases, nitrite/nitrate, unknown, acetaminophen, hydroxychloroquine, and rasburicase were the most common. Patients with a fatal outcome from exposure to nitrites/nitrates were younger and most often coded as intentional suicide attempts.

Conclusions: Overall, we found dapsone to be the most common agent for MetHb but not frequently associated with death. Nitrites/nitrates were among the most common causes of MetHb, to receive methylene blue, and the most likely to cause fatalities. Limitations of this study include its retrospective nature and the potential for coding variability.

KEYWORDS Methemoglobin; methylene blue; nitrites

andrew.chambers@vcuhealth.org

90. Encanto! Elucidating new cannabinoid-associated neurotoxicity objectively

Jennifer Mabey[a], Kerry Roarke[b] and Mark J. Neavyn[b]

[a]Maine Medical Center, Portland, ME, USA; [b]Northern New England Poison Center, Portland, ME, USA

Background: Symptoms of cannabis intoxication in children can overlap with other significant neurologic pathologies. Here we discuss two pediatric cases of cannabis associated neurotoxicity (CANT) and how blood cannabinoid concentrations changed clinician assessment and patient disposition.

Case series: Case 1 A 6-month-old female presented to the emergency department (ED) with somnolence after falling off a couch. She developed seizure-like activity and received lorazepam and levetiracetam. On exam she had minimally responsive dilated pupils and no evidence of trauma. Labs and head CT were unremarkable. Urine drug screen was positive for carboxy-THC. Since the patient is exclusively nursed by mother with chronic cannabis use, there was a question of passive maternal cannabis exposure. The poison center (PC) was consulted and recommended blood and urine quantitative analysis. Specimens drawn 24–36 h post-exposure showed blood carboxy-THC levels 189 ng/mL and 423 ng/mL in urine. The patient returned to baseline by 72 h. Child Protective Services (CPS) was involved to aid in the safe disposition of the child. Case 2 A 3-year-old female with Multiple Endocrine Neoplasia (MEN) 2A and family history of epilepsy presented with seizure-like activity. She spent the night at her grandmother's house and in the morning reported eye pain and dizziness. In the ED she became tonic and received lorazepam. She was tachycardic and intermittently responsive to name. Labs and head CT were unremarkable. Urine drug screen was positive for carboxy-THC. PC was consulted and

recommended blood quantitative analysis. Specimens drawn 12–24 h post-exposure showed THC 23.8 ng/mL, carboxy-THC 169.1 ng/mL, and hydroxy-THC 21.2 ng/mL. The grandmother later reported giving the child a chocolate edible the night prior to presentation. The patient returned to baseline at 24 h and was discharged home.
Discussion: Successful blood quantification of cannabinoids is highly dependent on the route of exposure. Smoked cannabis causes a peak blood delta-9-THC concentration within 20 min and becomes undetectable as early as 3 h. Oral exposures take several hours to achieve peak concentrations and can take over 24 h to become undetectable. Since the primary route of clinically significant exposures in young children is oral, this population is more likely to have relevant findings with cannabinoid quantification. Passive exposure is often a clinical confounder in the setting of parental cannabis use. In both cases, patients presented with undifferentiated neurologic changes. In Case 1, clinicians were concerned for closed head injury, and urine THC screening may have initially been explained by passive exposure through heavy maternal use. Because cannabinoid concentrations were inconsistent with passive inhalational exposure or breast milk alone, CPS reviewed the case to determine a safe disposition plan. For Case 2, the cannabinoid quantification helped determine that symptoms were from an edible exposure rather than a sequela of MEN or seizure disorder.
Conclusions: There is limited literature describing the pharmacokinetics of oral cannabis in young children with CANT. Quantification of cannabinoids in young children with a positive THC screening assay may differentiate causes of neurologic changes. PCs play an important role in the interpretation of these results.

KEYWORDS Cannabis; pediatric; analytical toxicology
jennifer.mabey@mainehealth.org

91. Epidemiology of hydrocodone exposures reported to the US poison centers

Saumitra Rege, Will Goodrich and Christopher Holstege
University of Virginia, Charlottesville, VA, USA

Background: Drug overdoses are a leading cause of unintentional injury-associated death in the US (US.) with 100,306 fatalities in 2021. Opioid dispensing rates continue to remain very high in certain areas across the country. According to the U.S Drug Enforcement Administration, 24.4 million individuals used hydrocodone for non-medical purposes. Emergency department (ED) visits for opioid overdoses rose 30% in all parts of the US from July 2016 through September 2017. This study aims to examine the national trends in hydrocodone exposures reported to US poison centers (PCs).
Methods: The National Poison Data System (NPDS) was queried for all closed, human exposures to hydrocodone from January 01, 2015 through December 31, 2021 using the American Association of Poison Control Center (AAPCC) generic code identifiers. We identified and descriptively assessed the relevant demographic and clinical characteristics. Reports from acute care hospitals and hospital based EDs (ACHs) were evaluated as a subset. Trends in hydrocodone exposure frequencies and rates (per 100,000 human exposures) were analyzed using Poisson regression methods. Percent changes from the first year of the study (2014) were reported with the corresponding 95% confidence intervals (95% CI).
Results: During the study period, there were 106,078 toxic exposures to hydrocodone that were reported to the PCs. The frequency of exposures decreased by approximately 50% (95% CI: 45.5%, 53.3%; $p < 0.001$), and the rate of exposures significantly decreased by 57% (95% CI: 48.2%, 65.9%; $p < 0.001$). Of the total hydrocodone calls, the proportion of calls from ACHs was approximately 55%, with this trend remaining constant through the study period. Multiple substance exposures accounted for 56.7% of the overall hydrocodone calls and 70.1% of calls from ACHs. Approximately 18% of the patients reporting hydrocodone exposures were admitted to the critical care unit (CCU), with 13% of patients being admitted to a psychiatric facility. Residence was the most common site of exposure (94.3%), and 62% of these cases were enroute to the hospital via EMS when the PC was notified. Cases were predominantly female (61.3%), with the most common age group being 20–29 years (16.2%) followed by 30–39 years (13.6%). Suspected suicides (45.2%) was the most common reason for exposure, followed by therapeutic errors (20.3%), with exposures for both reasons being higher in cases reported by ACH. Major effects and moderate effects were seen in 6.1% and 20.6% cases, respectively. There were over 600 deaths during the study. The most frequently co-occurring substances associated with the cases were benzodiazepines (17%) and alcohol (9.7%).
Conclusions: PC data demonstrated a decreasing trend of hydrocodone exposures, which may in part be attributed to the reformulation of this medication with abuse-deterrent properties. However, the high proportion of calls from acute-care hospitals and EDs indicates higher risk of such exposures which may be mediated by several clinical and demographic factors.

KEYWORDS Opioids; overdose; national poison data system
svr5d@hscmail.mcc.virginia.edu

92. Impact of an education module on the knowledge and attitudes of emergency physicians towards prescribing buprenorphine for opioid-use disorder

Amy Zosel, Jennifer Hernandez-Meier, Julie Owen, Jonathon Birdsall, Jamie Jasti and Jeffrey Liu
Medical College of Wisconsin, Milwaukee, WI, USA

Background: The COVID-19 pandemic has exacerbated the existing opioid epidemic, contributing to an increase in overdose-related deaths. Buprenorphine is an important treatment for patients with opioid-use disorder (OUD) and initiation in the Emergency Department (ED) has been shown to improve outcomes for these patients. Our objective was to assess the impact of a three-pronged education module on the knowledge and attitudes of emergency medicine (EM) physicians towards using buprenorphine for the treatment of OUD.
Methods: We developed a three-pronged educational module including rationale for OUD treatment with buprenorphine, an evidence-based ED buprenorphine induction pathway and electronic medical record tools (documentation templates, order sets and discharge instructions) that were deployed to providers in an urban academic ED. A voluntary anonymous pre-post survey was administered. Using a 6-point Likert Scale, participants were asked about their understanding, experience, and confidence with prescribing buprenorphine for patients with OUD. Descriptive statistics were applied.
Results: Forty-nine subjects participated, including approximately two-thirds faculty physicians and one-third residents. A minority of respondents were female (37%). Most (80%) had no direct experience in prescribing buprenorphine. When asked if buprenorphine reduces the likelihood of death from opioid overdose,

22% of pre-education respondents disagreed compared to zero post-education respondents. When asked if they were open to prescribing buprenorphine, pre and post responses with "Highly Agree" increased from 39% to 57% respectively. When asked about whether they felt confident in their ability to treat OUD with buprenorphine, 36% of pre-education respondents disagreed compared to 3% of post-education respondents.
Conclusions: A 1-hour three-pronged educational module (rationale for OUD treatment with buprenorphine, evidence-based ED buprenorphine induction pathway and electronic medical record tools), changed the attitudes of EM physicians towards buprenorphine treatment and demonstrated an increase in willingness and confidence to prescribe it for patients with OUD.

KEYWORDS Buprenorphine; opioid use disorder; education

azosel@mcw.edu

93. Opioid exposures reported to the US poison centers during the COVID-19 pandemic

Saumitra Rege, Ryan Cole and Christopher Holstege
University of Virginia, Charlottesville, VA, USA

Background: Misuse of prescription opioids continues to be a significant public health crisis globally. According to the Centers for Disease Control and Prevention (CDC), there were more than 72,000 overdose deaths in the US (US), with 49,068 involving an opioid. Preliminary reports from states and cities indicate that overdose death rates are further increasing during the COVID-19 pandemic. The present study sought to evaluate the recent trends in the severe outcomes to single substance opioid exposures (SSO) reported to the US poison centers (PCs).
Methods: The National Poison Data System (NPDS) was queried for all closed, human exposures to opioids from January 01, 2015 through December 31, 2021 using the American Association of Poison Control Center (AAPCC) generic code identifiers. We identified and descriptively assessed the relevant demographic and clinical characteristics. Reports from acute care hospitals and hospital based EDs (ACHs) were evaluated as a subset. Trends in opioids exposure frequencies and rates (per 100,000 human exposures) were analyzed using Poisson regression methods. Percent changes from the first year of the study (2014) were reported with the corresponding 95% confidence intervals (95% CI).
Results: During the study period, there were 458,285 toxic exposures to opioids that were reported to the PCs. The frequency of exposures decreased by approximately 28% (95% CI: 25.5%, 30.4%; $p < 0.001$), and the rate of exposures significantly decreased by 26% (95% CI: 23.2%, 31.7%; $p < 0.001$). Of the total opioids calls, the proportion of calls from ACHs was approximately 56%, with this trend remaining constant through the study period. Multiple substance exposures accounted for 51.7% of the overall opioids calls and 59.9% of calls from ACHs. Approximately 17% of the patients reporting opioids exposures were admitted to the critical care unit (CCU), with 10% of patients being admitted to a psychiatric facility. Residence was the most common site of exposure (88.3%), and 66% of these cases were enroute to the hospital via EMS when the PC was notified. Cases were predominantly female (53.6%), with the most common age group being 20–29 years (18.2%) followed by 30–39 years (17.1%). Suspected suicides (33.2%) was the most common reason for exposure, followed by intentional abuse (20.3%), with exposures for both reasons being higher in cases reported by ACH. The proportion of cases reporting intentional abuse as the reason for exposure increased significantly during the study (12–22%). Major effects and moderate effects were seen in 11.6% and 23.2% cases, respectively. The case fatality rate was 1.3% and the proportion of fatalities increased significantly during the study period (491–792). The most frequently opioid was hydrocodone while benzodiazepines were the most commonly reported co-occurring substances.
Conclusions: opioid exposures reported to the poison centers during the study period decreased but exposures reported from ACHs increased significantly. Mortality due to opioid exposures also demonstrated an increase. The impact of COVID-19 on the opioid crisis needed further attention.

KEYWORDS Opioids; National Poison Data System; overdose

svr5d@hscmail.mcc.virginia.edu

94. Acute necrotizing eosinophilic myocarditis and sudden death in a patient with metformin associated metabolic acidosis

Carin Malley[a], Erin Gramm[b], Alek Adkins[a], William Trautman[a], Matthew Scanlon[a], Michael Abesamis[a] and Anthony Pizon[a]
[a]University of Pittsburgh Medical Center, Pittsburgh, PA, USA;
[b]University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Background: Acute necrotizing eosinophilic myocarditis (ANEM) is characterized by rapid onset of ventricular dysrhythmias, biventricular failure, and death. It is frequently associated with conditions that cause peripheral eosinophilia such as chronic eosinophilic leukemia, parasitic infection, and eosinophilic granulomatosis with polyangiitis. It is also associated medications including sulfonylureas, various antibiotics, and ACE inhibitors. We present a case of fatal ANEM in a patient initially admitted after an overdose of metformin, sitagliptin, empagliflozin, and sertraline. None of these medications have been previously linked to eosinophilic myocarditis.
Case report: A 33-year-old woman with past medical history of type 2 diabetes on metformin, sitagliptin, glimepiride, and empagliflozin presented to a community hospital after an intentional overdose. Initially awake and alert, she reported ingesting approximately 100 g metformin and an unknown amount of sitagliptin, empagliflozin, and sertraline. Over several hours, she became increasingly hypotensive with a rising lactate despite fluid resuscitation. She suffered a respiratory arrest followed by an approximately 4-min ventricular fibrillation cardiac arrest. She was intubated and defibrillated with return of spontaneous cardiac activity. She was started hemodialysis (HD) for metformin associated metabolic acidosis (MAMA). She continued to deteriorate with hypotension despite multiple vasopressors. Her echocardiogram showed an ejection fraction (EF) of approximately 10%. HD was discontinued after approximately 1.25 h, and she was canulated for peripheral veno-arterial extracorporeal membrane oxygenation and transferred to a tertiary care center. On arrival to the tertiary care center, she had a lactate of 27.0 mMol/L. She underwent 6.5 h of HD with improvement of her lactate to 4.0 mMol/L and she was transitioned to continuous renal replacement therapy (CRRT). Her urine liquid chromatography mass spectroscopy (LCMS) was positive for sitagliptin, caffeine metabolite or theophylline, nicotine metabolites, metformin, sertraline. She continued to have intermittent episodes of ventricular tachycardia. On post-overdose day #2 a right axillary impella device was implanted for left ventricular venting. On post-overdose day #4, she developed intracranial embolic infarcts and pulmonary emboli. She was made comfort care and expired. Autopsy results showed extensive eosinophilic myocarditis with myocyte necrosis

consistent with ANEM. Her metformin level drawn on arrival to the tertiary care facility was 14 mcg/mL, consistent with MAMA.
Discussion: We present a fatal case of ANEM after an overdose of metformin, sitagliptin, sertraline, and empagliflozin. None of these medications are known to be associated with ANEM and she had not filled any prescriptions for ANEM associated medications within 24 months of her death. She did not have elevated circulating peripheral eosinophils as would be expected in patients with a parasitic infection or malignancy as a cause of her ANEM. Finally, the rapid time course and associated overdose suggest a drug related correlation.
Conclusions: This case highlights an extremely rare presentation associated with an acute overdose of metformin, sitagliptin, sertraline, and empagliflozin which either caused ANEM or contributed to rapid decompensation of previously undiagnosed asymptomatic ANEM.

KEYWORDS Metformin; myocarditis; ECMO

malleyck@upmc.edu

95. Evaluation of virtual online delivery of United Nations Office on Drugs and Crime (UNODC) national training on novel psychoactive substances (NPS) to healthcare professionals in Mauritius and the Seychelles during the COVID-19 pandemic

David Wood[a], Fayzal Sulliman[b], Giovanna Campello[c] and Anja Busse[d]

[a]Guy's and St Thomas' NHS Foundation Trust, London, England; [b]UNODC Regional Adviser for Eastern Africa on Drug Demand Reduction and HIV/AIDS, Nairobi, Kenya; [c]Prevention, Treatment and Rehabilitation Section, United Nations Office on Drugs and Crime, Vienna, Austria; [d]Programme Officer, Prevention, Treatment and Rehabilitation Section, UNODC, Vienna, Austria

Background: Previous studies have highlighted that clinicians have less knowledge and confidence in managing acute toxicity related to NPS compared to recreational drugs. To address this, the United Nations Office on Drugs and Crime (UNODC) organise national training programmes for the healthcare professionals on the clinical management of NPS toxicity. Prior to the COVID-19 pandemic, this would be delivered face-to-face. This study investigates virtual delivery of this training during the COVID-19 pandemic to a group of healthcare professionals in Mauritius and the Seychelles.
Methods: Three virtual online training sessions were delivered by a UK based toxicology expert to healthcare professionals (physicians, nurses, psychologists and other allied healthcare professionals) working in Mauritius and the Seychelles in November 2021. Attendees completed a pre- and post-training questionnaire on their knowledge of and confidence in managing acute toxicity related to controlled substances and NPS. This questionnaire Participants self-assessed using scale of 1–5 for each variable: Knowledge: 1 = little knowledge to 5 = very knowledgeable; Confidence: 1 = little confidence to 5 = very confident. Pre-training controlled substances and NPS knowledge and confidence between were compared by a paired student *t*-test; pre- and post-training knowledge and confidence were compared by unpaired student *t*-test. In the post-training questionnaire attendees also provided qualitative feedback on the impacts of training to their future practice, and also whether they would prefer future training to be delivered in person or virtually.
Results: 32 and 24 attendees completed the pre- and post-training questionnaire respectively. Prior to the virtual training sessions, attendees had greater knowledge and confidence in managing acute controlled substances toxicity compared to acute NPS toxicity: Knowledge 2.9 ± 0.8-vs-2.3 ± 0.8, $p < 0.001$; Confidence 2.9 ± 0.9-vs-2.4 ± 0.8, $p < 0.001$. Following the virtual training sessions, there was a significant increase in the knowledge and confidence in managing acute toxicity related NPS; in addition due to the wider discussion of controlled substances, there was also a significant increase in knowledge and confidence in managing their associated acute toxicity. Thematic review of the qualitative free text responses on the impact of the training identified the following themes: (i) improve their ability to help people/clients:12 participants; (ii) improved/greater knowledge:8 participants; (iii) clinical management of drug issues:5 participants; and (iv) educate others:1 participant. The majority of participants (19,79.2%) would have preferred this training to have been delivered in person rather than virtually.
Conclusions: Virtual delivery of UNODC national training on acute NPS toxicity during the COVID-19 pandemic increases the knowledge and confidence of healthcare professionals on managing acute controlled substance and NPS toxicity. Despite this positive impact, attendees would still prefer to have training delivered in person rather than virtually. As we recover from the COVID-19 pandemic, how training is delivered going forwards should consider attendees preferences and not favour potentially "cheaper" virtual training. Disclaimer For the authors affiliated/working with the United Nations (UN), the authors themselves are responsible for the content and it does not necessarily reflect the views of the United Nations

KEYWORDS Novel psychoactive substance; recreational drug; education

David.Wood@gstt.nhs.uk

96. Evaluation of pediatric lisdexamfetamine exposures reported to a statewide poison control system

Justin Lewis[a], Abigail Takacs[b] and Ruixin Shi[b]

[a]California Poison Control System – Sacramento Division, Sacramento, CA, USA; [b]University of California Davis Health, Sacramento, CA, USA

Background: The weight-based, symptom-producing dose of extended-release amphetamine products is not well defined. The objective of this study was to describe the clinical effects developed after lisdexamfetamine ingestion to better understand what dose-response relationship poison centers can consider when establishing referral guidelines.
Methods: This retrospective, Institutional Review Board approved study analyzed patient cases within a statewide poison control system's database between February 1, 2015 and November 1, 2021 for single-substance ingestions of lisdexamfetamine in patients under age 17 evaluated in a healthcare facility. Chart notes for each case were reviewed by a Clinical Toxicologist and an Emergency Medicine Pharmacy Resident. Cases were excluded if the dose, weight, or medical outcome were unknown, if the patient was not stimulant naive, if activated charcoal was administered, or if the reason for exposure was suspected self-harm. Data points included age, sex, weight, dose, clinical effects, treatments performed, whether hospital admission occurred, and length of stay.
Results: A total of 458 cases were identified but only 20 cases met inclusion criteria. Twelve cases (60%) developed minor effects. Lisdexamfetamine doses causing minor effects ranged

from 20–60 mg (1.1–3.2 mg/kg). The lowest dose to cause clinical effects occurred in an 18 kg, 3-year-old male child who was witnessed to ingest a 20 mg (1.1 mg/kg) lisdexamfetamine capsule. He was observed in the ED for 5 h and required no interventions. A change in mental status and tachycardia were the only symptoms. The largest dose resulting in minor effects occurred in a 9-month-old female who ingested 30 mg, developed tachycardia, and was admitted overnight; no treatments were performed. Heart rate returned to baseline the next morning. Two cases (10%) resulted in moderate effects. Lisdexamfetamine doses resulting in moderate effects ranged from 30–60 mg (3.16–5.13 mg/kg). A 11.7 kg, 20-month-old female ingested 60 mg of lisdexamfetamine, developed insomnia, repetitive movements, agitation, and hypertension. No interventions were performed; she was hospitalized overnight, and symptoms resolved within 24 h post-ingestion. The second case involved a 9.5 kg, 10-month-old female who ingested 30 mg of lisdexamfetamine. She developed agitation, insomnia, agitation, tachycardia, hypertension, and tachypnea. She was treated with intravenous fluids and repeat doses of lorazepam and was admitted. She returned to baseline by 48 h post-ingestion. Six cases (30%) resulted in no effect. Lisdexamfetamine doses in the no-effect group ranged from 20–50 mg (0.7–2.7 mg/kg). All patients were observed in the ED for at least 4 h, except one case where the bedside toxicologist cleared the patient after 3 h. None of the patients in the no-effect group had a urine drug screen performed; it is possible some patients were not exposed despite a convincing history.

Conclusions: The lowest dose of ingested lisdexamfetamine in a stimulant-naïve patient to cause symptoms was 1.1 mg/kg and produced mild tachycardia and hyper-alertness which resolved without intervention. Poison centers should consider this data when establishing lisdexamfetamine referral thresholds; however, further studies are warranted.

KEYWORDS Lisdexamfetamine; pediatric; poisoning

jlewis@calpoison.org

97. Ibuprofen poisoning with refractory shock treated with extracorporeal membrane oxygenation

Cody Williams[a], Seema Patel[a], Mary Wermuth[a] and Marielle Brenner[b]

[a]Indiana University School of Medicine, Indianapolis, IN, USA; [b]University of Iowa, Iowa City, IA, USA

Background: While ibuprofen overdose is often asymptomatic or mildly symptomatic, large ingestions can cause cardiovascular collapse, kidney injury, and gastrointestinal (GI) bleeding. There are increasing reports of extracorporeal membrane oxygenation (ECMO) used in medication overdose, but it is rarely used for ibuprofen poisoning. Here, we report a very rare case of veno-arterial (VA) ECMO to successfully treat ibuprofen poisoning.

Case report: 17-year-old non-binary gendered patient, female sex at birth, presented with an intentional ingestion of approximately 40 g of ibuprofen. Initially they had nausea and several episodes of nonbilious non-bloody emesis. They presented hemodynamically stable with a bicarbonate concentration of 21 mmol/L and a creatinine of 0.9 mg/dL. Acetaminophen, salicylate, and ethanol levels were undetectable; however, urine drug screen was positive for tricyclic antidepressants (TCAs). Review of medications in the home revealed no TCAs or other medications known to cause a false positive except diphenhydramine. The primary team declined TCA confirmatory testing. ECG on arrival showed sinus tachycardia with rate of 116, QTc 453 ms, and QRS 106 ms. Approximately 12 h after arrival, they became obtunded and developed shock, requiring endotracheal intubation and vasopressor support. They developed an anion gap metabolic acidosis with an elevated lactate level. A serum ibuprofen level obtained 24 h post ingestion was 350 mcg/mL (therapeutic range: 17–36 mcg/mL). This concentration has previously been reported as fatal in a similar patient despite supportive care. Their hypotension and acidosis continued to worsen despite maximal dosing of norepinephrine, epinephrine, vasopressin and sodium bicarbonate infusions prompting initiation of VA ECMO. Their course was complicated by an acute kidney injury (AKI) and an upper GI bleed. Lactate and creatinine peaked at 18.6 mmol/L and 1.69 mg/dL respectively. pH and hemoglobin nadirs were 6.99 and 7.8 gm/dL respectively. Acidosis, AKI, and GI bleeding gradually improved with pantoprazole and aminocaproic acid infusion. ECMO was discontinued after a total of 40 h on the circuit. They were extubated on day 4 with no apparent neurologic, renal, or cardiovascular sequelae and transferred to an inpatient psychiatric facility on day 10 of hospitalization.

Discussion: Complications from ibuprofen overdose are typically mild. Few cases become severely symptomatic, but large ingestions have resulted in GI hemorrhage, acute renal failure, seizures, central nervous system depression, metabolic acidosis, and shock. Death from ibuprofen poisoning is an even more rare outcome. Inotropic support may be inadequate in overdoses that result in circulatory collapse due to profound acidosis. Given the high plasma protein binding nature of ibuprofen, hemodialysis has no role in assisting elimination from the body, however, it can be used to improve severe acidosis. In situations that combine these circumstances, VA ECMO is well-suited as a therapeutic option.

Conclusions: While the use of ECMO in acutely poisoned patients is not widespread, it provides cardiovascular support while treating acidosis and allowing metabolism of the ingested substance. This is particularly important in cases without an antidote or other adequate mechanism of clearance, such as ibuprofen.

KEYWORDS Ibuprofen; ECMO; metabolic acidosis

codjwill@iu.edu

98. COVID 19 test kit exposures

Matthew Novak and Michael Wahl

Illinois Poison Center, Chicago, IL, USA

Background: With the ongoing Coronavirus Disease (COVID19), the capability to test for the disease at home has expanded greatly. As with many consumer products, unintentional ingestion can occur in the home for a variety of reasons. While toxicity from these products is suspected to be low, the widespread use of any new consumer product can have unforeseen consequences. It was also unclear to what extent exposures to COVID19 test kits would correlate to trends in overall COVID19 infections.

Methods: A retrospective review of the National Poison Data System (NPDS) January 1, 2021 to March 31, 2022 for all ingestions with the NPDS product codes for COVID19 at-home test kits were conducted. This data were also compared to Centers for Disease Control and Prevention data on new COVID19 cases per 100,000 population during the study period and compared with exposures reported to US poison centers and analyzed with Pearson's correlation co-efficient.

Results: A total of 258 cases were identified, 180 (69.8%) patients were under the age of 6 years old, and 78 (30.2%) were 6 years old or older. For patients under the age of 6, nearly all the exposures were unintentional general (177/180 cases) with the remainder being contamination 1, unintentional misuse 1, and

therapeutic error 1. For all patients the reason for exposure were unintentional general 228, unintentional misuse 45, contamination 3, intentional misuse 3, therapeutic error 2, adverse effect 1, and environmental 1. Clinical effects for patients under the age of 6 were vomiting 2, oral irritation 1, and diarrhea 1. Clinical effects for all patients were oral irritation 5, vomiting 4, respiratory other 3, nausea 2, abdominal pain 1, diarrhea 1, dermal irritation 1, and other miscellaneous 1. No clinical effect was coded in 235 exposures. A comparison of monthly exposures recorded in NPDS with CDC positive test results with Pearson's correlation coefficient had an R-value of 0.6175 which indicates a moderately positive correlation, however the *p*-value of the test was >0.05.

Discussion: In a 7-month retrospective review of NPDS data, ingestion exposures to COVID19 Test Kits went from 7 in September 2021 to a peak of 76 in January 2022, an increase of 1085%. By March 2022, exposures decreased to 41, a 46% decrease. While peak ingestion exposures to COVID19 Test kits reported to US Poison Centers matched the peak in new cases of COVID19, exposures to COVID19 test kits rose more gradually and declined slower from their peak when compared to new cases of COVID19. Ingestion exposures to COVID19 test kits were well tolerated as only 11 (4%) of the cases followed had minor effect and clinical effects were minimal.

Conclusions: Exposures to COVID19 tests kits exposures had a moderate correlation with reported new cases of COVID19. This correlation was not statistically significant but with only 7 months of data, the study was underpowered and more surveillance will be needed to adequately power the study. COVID19 test kits pose little risk of toxicity and accidental ingestion of these products can be managed at home.

KEYWORDS COVID19; test kit; ingestion

mnovak@team-iha.org

99. A case report highlighting clearance of sotalol via hemodialysis in an acute overdose

Christian Kressin[a], Alex Peterson[a], Regan Baum[b], Sadiq Ahmed[a], Anil Gopinath[a] and Andrew Micciche[a]

[a]University of Kentucky, Lexington, KY, USA; [b]UK HeathCare, Lexington, KY, USA

Background: Beta blocker overdoses are a relatively common presentation with potential for significant morbidity and mortality. Overdoses of sotalol are unique in comparison to other beta blockers given their class III antiarrhythmic effects and potential for treatment with hemodialysis. There is not much literature that investigates the clearance of sotalol via hemodialysis in acute overdoses. We present a case report of a sotalol overdose treated with hemodialysis with both pre- and post-hemodialysis serum sotalol levels.

Case report: A 53-year-old female presented to the emergency department (ED) following an intentional overdose of fifteen 80mg sotalol tabs. In the ED the patient was somnolent with initial heart rates in the 30s and systolic blood pressures in the 80s and 90s. Initial EKG revealed sinus bradycardia without QTc interval prolongation. Initial creatinine of 0.95 mg/dL with unknown baseline. The patient was started on norepinephrine for hemodynamic support. The patient then had an episode of polymorphic ventricular tachycardia and subsequent EKG revealed sinus bradycardia with a QTc interval of 643 ms. She was administered 2 g of magnesium sulfate and started on isoproterenol with uptitration to 20 mcg/min. Hyperinsulinemia euglycemia protocol was initiated in the ICU with a 60 unit insulin bolus followed by continuous infusion at 0.5 μ/kg/h. Given persistent bradycardia and hypotension, the patient underwent 3 h of hemodialysis on the day of admission. Serum sotalol levels drawn before and after hemodialysis were 4700 ng/mL and 2200 ng/mL, respectively. The following day the patient underwent an additional 4 h of hemodialysis. Serum sotalol levels drawn before and after the second round of hemodialysis were 1000 ng/mL and 470 ng/mL, respectively. Hemodialysis sessions were separated by approximately 14 h. QTc interval prolongation resolved between the two dialysis sessions. The patient ultimately did well and was discharged on hospital day 3.

Discussion: Sotalol is a class III antiarrhythmic with additional class II beta-adrenergic blockade activity. The principles of treating sotalol toxicity are based on the general management of any patient with beta blocker poisoning, with a few specifics derived from its characteristic pharmacokinetics and pharmacodynamics. Sotalol has low lipophilicity, no protein binding, a half-life of 7–15 h, and is excreted unchanged by the kidneys with the half-life being significantly prolonged in renal dysfunction. For these reasons, clearance can be augmented via hemodialysis. In our patient, utilizing a Revaclear 400 dialyzer (Baxter), we were able to achieve a reduction ratio of 53% with each hemodialysis session, a significant amount when compared to what would be expected via renal clearance over the same timeframe.

Conclusions: In this case report we were able to document the effective elimination of sotalol utilizing a high flux dialyzer. While it is unclear how much this affected the patient's overall clinical course, there is little in the medical literature that specifically looks at this topic. While hemodialysis of sotalol is typically only advocated for in patients with significant renal dysfunction, results from this patient suggest possible utility for hemodialysis following sotalol overdose in patients with normal kidney function.

KEYWORDS Sotalol; overdose; hemodialysis

clkr225@uky.edu

100. A large outbreak of adulterated heroin with a unique and prolonged toxidrome in Reading, Pennsylvania

Sarah Weiss[a], Stephanie Tauscher[a], Rachael Trupp[a], Ross Ellison[b], Roy Gerona[b], Charnjeet Sandhu[a], Harpreet Singh[a], Parin Shah[a], William Finneran III[a], Jordan Trecki[c] and Adam Sigal[a]

[a]Reading Hospital, Tower Health, Reading, PA, USA; [b]University of California, San Francisco, San Francisco, CA, USA; [c]Drug Enforcement Administration, Washington, DC, USA

Background: Adulterated heroin is extremely common. In September 2021, our region had an outbreak of patients with unusual symptoms after using heroin, some lasting days. We estimated over 120 affected patients in cooperation with other hospitals and law enforcement beginning on September 11, 2021. We identified 94 patients at our institution by provider report and search of the electronic medical record and performed retrospective chart review. We obtained leftover initial serum or plasma from 49 patients for analysis via the Drug Enforcement Administration Toxicology Testing Program.

Case series: Patients aged 21–72 years (mean 45.4), and 79 (84%) were male. Sixty-five patients (69.1%) arrived via EMS and 55 (58.5%) were admitted to the hospital, including 5 to our step-down unit and 4 to the ICU. EMS dispatch reasons included 3 cardiac arrests; two achieved resuscitation and one patient expired in the emergency department. Presenting complaints included drug overdose or adverse effect ($n = 63$, 67%), generalized weakness (12, 12.8%), syncope (8, 8.5%), bradycardia (7,

7.4%), fall (4, 4.3%), and dizziness (4, 4.3%). Vital signs on presentation were noteworthy for bradycardia and hypertension, with 57 patients (62%) having heart rates less than 60 beats per minute (average 59, IQ R 45–65.5), 31 (33%) with systolic blood pressure over 160 mmHg and 25 (26.6%) with diastolic blood pressure above 100 mmHg. The average respiratory rate was 17 (IQR 16–19) with only two patients having initial rates less than 10 breaths per minute. Of 66 patients who had troponin measured, 28 (42.4%) were positive, and peaks ranged from 0.03–11.7 ng/mL. Thirty-five patients had echocardiograms, of whom ten (28.6%) showed diastolic dysfunction. Most patients who presented bradycardic and hypertensive remained so for the duration of their hospital stay, often several days. Of 49 serum/plasma samples, all tested positive for an as-of-yet unknown compound. Forty-two (85.7%) tested positive for fentanyl and/or metabolites, 42 (85.7%) for heroin metabolites, 15 (30.6%) for para-fluorofentanyl and/or metabolites, and 21 (42.9%) for cocaine and/or cocaine metabolites. Forty-seven (95.9%) were positive for xylazine with an average concentration 10.6 ng/mL (IQR 2.35–11.95). Forty-four (90%) tested positive for clonidine with the average concentration 8.67 ng/mL (IQR 4.2–9.1). Other frequently detected compounds were lidocaine ($n = 35$,) acetaminophen ($n = 12$), methadone and/or metabolites ($n = 12$), 11-nor-9-carboxy-delta-9-THC ($n = 11$), and naloxone ($n = 10$).

Discussion: This is a large outbreak of adulterated heroin producing a toxidrome characterized by weakness, syncope, bradycardia, and hypertension, associated with increased troponin and diastolic dysfunction. The toxidrome lasted hours to days, unusual for substances of abuse. The unknown chemical may represent a novel psychoactive substance; we are currently testing the alternative of post-collection contamination. The duration of hypertension is rare for xylazine or clonidine overdose alone but could be due to synergy of the two agents or additional effect from the unknown substance.

Conclusions: This toxidrome may be attributed to high serum levels of clonidine and xylazine. However, heroin and fentanyl are often tainted with alpha-2 adrenergic agonists, but a similar toxidrome is uncommon. The detection of an unknown compound presents the possibility of a potentiating or syndrome-prolonging agent that is yet to be determined.

KEYWORDS Adulterants; toxidrome; heroin

Sarahjweiss@gmail.com

101. Challenges associated with ethylene glycol toxicity in austere environments

Joseph Clemons

Oregon Health and Science University, Portland, OR, USA

Background: Remote and austere environments pose unique challenges to the timely and appropriate treatment of ethylene glycol (EG) toxicity. Patients suffering from EG poisoning are at increased risk for delayed manifestations of their toxicities without timely intervention. Many austere settings may lack the traditional healthcare facilities, staff, and treatments that toxicologists are accustomed to. Patients may also depend on health aids unfamiliar with managing EG toxicity. Further limiting factors can arise due to local laws and regulations restricting novel antidotes such as ethanol (EtOH) containing spirits or beverages. Therefore, patients in austere environments can require non-traditional treatment solutions to manage their EG toxicity.

Case report: A 49-year-old male presented to a health clinic 6 h after ingesting approximately (∼) 16 oz (473.1 mL) of 50/50 EG containing antifreeze. The location of the health clinic was in a remote village of ∼200 people lacking outside access except via airlift. Peak serum EG concentration was estimated to be 618.6 mg/dL (134.2 mmol/L). Initial challenges to treatment arose due to the health clinic's lack of fomepizole and inclement weather preventing immediate patient transfer. Additional treatment roadblocks occurred due to local prohibition on the sale and use of EtOH-containing products such as spirits, beer, mouthwash, or cooking sherry. Attempts were made to contact local State Troopers to obtain confiscated EtOH without success. State Troopers stated, "All alcohol confiscated is disposed of on-site during a seizure." The local health aid eventually obtained 6 oz (177.4 mL) of expired vanilla extract (∼41% EtOH) and ∼16 oz (473.1 mL) of 70% isopropyl alcohol (IPA) from surrounding community members. The patient was subsequently given a loading dose of 90 mL of vanilla extract and instructed to ingest 60 mL of the extract every 4 h afterward. Once the vanilla extract ran out, 40 mL of 70% IPA would be administered every 4 h until medical evacuation could airlift the patient to the closest medical center the following morning. Approximately 24 h after the initial EG ingestion, the patient arrived at a regional medical center where he received treatment with fomepizole. Eventually, the patient was discharged to an inpatient psychiatric facility.

Discussion: This case presents the unique challenges of treating EG toxicity in an austere setting. Traditional treatment of EG toxicity involves inhibition of alcohol dehydrogenase with fomepizole or EtOH. Other methods include the removal of EG and its metabolites via hemodialysis. In austere locations without these treatment modalities, non-traditional methods may be needed. EtOH-containing household products include vanilla extract (∼35–40% EtOH), mouthwash (∼22% EtOH), and hand sanitizer (∼67% EtOH). In addition, EtOH may be found in various products such as cough syrups or perfumes. If EtOH-containing products are unavailable, IPA may also be used to inhibit alcohol dehydrogenase. Nevertheless, treatment with IPA may be limited due to difficulty with oral ingestion.

Conclusions: Remote and austere environments present unique challenges to treating EG toxicity. If standard treatments are unavailable, a practitioner may consider other modalities such as ethanol containing household products or IPA.

KEYWORDS Ethylene glycol; austere; remote

clemons@ohsu.edu

102. Stop and smell the onions: case report of delayed cardiotoxicity post ingestion of veratrum viride

Michael Yu, Victoria Frankl, Mark Neavyn and Karen Simone

Northern New England Poison Center, Portland, ME, USA

Background: *Vertatrum viride* (false hellebore) is a perennial commonly found in eastern North America. The most common cause of exposure is misidentification when foraging for wild onion, or skunk cabbage. One regional poison center saw an increase in foraging-related poisonings during initial COVID-19 restrictions. The case report highlights severe delayed cardiac effects after ingestion of *Veratrum viride* in an otherwise healthy, young, female athlete.

Case report: A 24-year-old female presented to an emergency room alongside family with complaints of nausea and vomiting that started 30 min after a meal consisting of foraged wild onion (*Allium triccocum*). Five others ate the same meal and noted similar symptoms. Vitals upon arrival (3 h post ingestion) are as described: HR 51, BP 88/52, Temp 36.7, RR 18 and O_2 sat 100% on room air. The patient had no previous cardiac history and was athletic. Management included D5LR with K replacement,

and dopamine infusion at 10 mcg/kg/min. Dopamine was tapered slowly, down to 6 mcg/kg/min at 16.5 h. Vitals continued to be stable at 17.5 h post ingestion and dopamine was discontinued. The patient developed severe bradydysrhythmia 15 min later, consisting of complete heart block leading to prolonged sinus pause. She responded to 10 s of CPR with return of spontaneous circulation with a junctional escape rhythm which reverted back to sinus bradycardia. A repeat EKG was unremarkable. The dopamine infusion was reinstituted at 4 mcg/kg/min and continued until 26.5 h post ingestion. She was monitored an additional 9.5 h, and remained in sinus rhythm with mild complaints of dizziness that resolved before discharge.

Discussion: *Veratrum spp*. toxicity is due to alkaloids found throughout the plant which cause sodium channel opening when bound to type 2 sodium channels. By increasing sodium ion influx during the resting potential and delaying inactivation to create a late sodium current, these alkaloids increase automaticity in conductive cells. This mechanism, paired with the Bezold-Jarisch reflex, is likely responsible for increased vagal tone leading to bradycardia, hypotension, sinus arrhythmia, and junctional escape rhythm. It is noteworthy that even 18 h post ingestion in a relatively stable patient with no significant cardiac history, cardiac arrest occurred just after treatment tapering. Clinicians should consider prolonged observation time in the setting of discontinuation of vasopressors.

Conclusions: Both clinicians and amateur foragers should be aware of the risks associated with ingestion of *Veratrum viride*, especially during early spring when it more closely resembles wild onion. While uncommon, significant delayed cardiac effects are possible. Mistaking the plant for edible wild onions can be the difference between a delectable dinner, and a night in the ICU.

KEYWORDS Veratrum; cardiotoxicity; foraging

mbyu90@gmail.com

103. Don't make it a double?: a 20-year review of supratherapeutic amlodipine ingestions while on chronic therapy

Crystal Proshek, Stephanie Lynn Hon, Patrick Filkins and Robert Geller

Georgia Poison Center, Atlanta, GA, USA

Background: Amlodipine is a dihydropyridine calcium antagonist FDA approved in adults with a history of hypertension and coronary artery disease. Unintentional supratherapeutic doses of amlodipine are frequently reported to regional poison centers (RPC). Literature typically recommends any therapeutic misadventure of >10 mg be referred to a healthcare facility for potential toxicity. Our aim is to report the incidence and outcomes of exposures involving supratherapeutic doses of amlodipine managed by our RPC.

Methods: This is a single-center, IRB-approved, retrospective chart review from January 2000 to December 2020. All patients with a history of acute-on-chronic ingestions of amlodipine, a known amount ingested, and a documented outcome were included in the descriptive analysis.

Results: Over a 20-year period, 923 cases of supratherapeutic amlodipine cases were reported to our RPC. Only 268 cases met all inclusion criteria (29% of all cases). For all included exposures, the average age was 61.2 years with 72.8% females. There were six patients <18 yo and three adults of unknown ages. There were 206 cases describing exact known amounts ingested (76.9%), 37 with estimated amounts (13.8%), and 25 were described as maximum possible (9.3%). The amounts ingested ranged from 1.6 mg to 300 mg. For cases meeting inclusion criteria, 133 had been on amlodipine for >3 mos (49.6%), while 19 were <3 mos (7.1%) and 116 of unknown duration (43.3%). The most common symptoms reported were hypotension (13.6%) and dizziness (7.9%). No effects were reported in 166 (61.9%) of the cases. Out of 268 cases, 110 (41%) were managed at home and 152 (56.7%) were treated in a healthcare facility (HCF). Of those treated in a healthcare facility, 97 (61.4%) ingested <20 mg, and 61 (38.6%) > 20 mg. Of those who ingested 20 mg or less, 51 (52.6%) experienced no effects, 29 (29.9%) minor effects, and 17 (17.5%) moderate effects. Of those who experienced moderate effects, only 3 (1.1% of all cases) were single agent ingestions and none had more than minor effects that could be attributed to amlodipine. Of those that ingested >20 mg, 31 (50.8%) experienced no effects, 19 (31.1%) minor effects, 9 (14.8%) moderate effects, and 2 (3.3%) died. The average dose ingested and managed onsite was 17 mg (range 5–30 mg) compared to the average dose ingested in which hospital triage was recommended was 34.6 mg (range 1.6–300 mg). All six pediatric patients were treated in a healthcare facility for exceeding the current RPC guideline of >0.3 mg/kg amlodipine.

Conclusions: Twenty years of data from our RPC provides support that it may be reasonable to manage a single agent amlodipine ingestion of 20 mg or less at home in adults. Our current RPC uses >0.3 mg/kg in pediatric cases, and we expect to continue the current pediatric guidelines. Until further studies are conducted any symptomatic patients, patients on multiple blood pressure lowering agents who ingest more than their prescribed dose of amlodipine, or those ingesting >20 mg of amlodipine should continue to warrant HCF referral and evaluation. The inconsistency of coding and follow-up practices of the reporting poison center should be taken into consideration when identifying triage criteria.

KEYWORDS Amlodipine; double-dose; supratherapeutic

cproshek@georgiapoisoncenter.org

104. Development of methemoglobinemia in dogs after accidental exposure to acetaminophen (2002–2021)

Laura Stern and Tina Wismer

ASPCA Animal Poison Control Center, Urbana, IL, USA

Background: Acetaminophen (APAP) is a analgesic and antipyretic. Acetaminophen exposures represent a common call to both human and animal poison control centers. Both humans and dogs can develop centrilobular liver necrosis as a result of acetaminophen toxicosis. However, in dogs a prominent feature of acetaminophen overdosages is methemoglobinemia. Methemoglobinemia is theorized to develop in dogs due to the deacetylation of acetaminophen to para-aminophenol (PAP). In rodents, PAP undergoes n-acetylation and is excreted in the bile. Dogs lack the enzymes to catalyze this reaction, N-acetyltransferase 1 and N-acetyltransferase 2. Therefore, PAP accumulates and can reduce hemoglobin to methemoglobin. Additionally, dogs are more likely to develop methemoglobinemia, as they have four reactive sulfhydryl groups on their red blood cells, while humans only have two. Treatment of methemoglobinemia in dogs exposed to acetaminophen consists of N-acetylcysteine (NAC), oxygen, and supportive care.

Methods: The poison control database was queried for APAP cases between January 1, 2002 and December 31, 2021. Cases were limited to dog exposures to APAP only (no other exposures or agents with multiple active ingredients) with

methemoglobinemia assessed as high or medium likelihood of being related to the acetaminophen exposure.
Results: 97 cases of methemoglobinemia were documented in the AnTox database. The lowest dose documented causing methemoglobinemia was 90.9 mg/kg; however, that dosage was repeated 4 times q 12 h prior to the development of methemoglobinemia. The lowest documented single dosage causing methemoglobinemia was 148.0 mg/kg with the highest single dose documented at 5769.0 mg/kg. Methemoglobinemia was more commonly reported at dosages over 200 mg/kg. Final outcome was available in 14/97 (14.4%) of cases. Death or euthanasia was reported in 9/97 (9.3%) of cases and full recovery was made in 5/97 (5.1%) of cases. The sample size was too small to make any statistically significant conclusions about dosage or patient factors leading to an increased risk of death or increased chance of recovery.
Conclusions: Methemoglobinemia is a common complication to acetaminophen intoxication in dogs, due their inability to efficiently metabolize and excrete para-aminophenol. Methemoglobinemia should be monitored for in all dogs who ingest over 200 mg/kg of acetaminophen and in cases of repeated exposure. Early recognition of this condition is key to the successful management of acetaminophen intoxication.

KEYWORDS Acetaminophen; canine; methemoglobinemia

laura.stern@aspca.org

105. Characterizing the clinical effects of acute oral anticancer targeted agent ingestion reported to US poison centers

Lauren Wells[a], Carolyn Oxencis[b], Jillian Theobald[c], Ryan Feldman[d] and Matthew Stanton[d]

[a]Wisconsin Poison Center, Wauwatosa, WI, USA; [b]Froedtert and the Medical College of Wisconsin, Milwaukee, WI, USA; [c]Medical College of Wisconsin, Milwaukee, WI, USA; [d]Froedtert and the Medical College of Wisconsin, Medical College of Wisconsin School of Pharmacy, Brookfield, WI, USA

Background: Oral anticancer targeted agents (OATA) are small molecules that target intracellular signaling pathways as opposed to interrupting cellular synthesis like traditional chemotherapy and are generally less toxic with chronic use. There are nearly 80 OATAs on the market presently, but little data is available to describe the adverse effect profile of acute OATA ingestions. The purpose of this study is to characterize the clinical outcomes from reported Poison Center encounters from the last 21 years.
Methods: This retrospective observational study used data from the National Poison Data System (NPDS). A data request including 79 OATAs was submitted to NPDS for ingestions occurring January 1, 2000- December 31, 2021. Data elements included age, gender, date of exposure, medical outcome, route of exposure, chronicity, clinical effects, therapy, and management site. Exposures that were non-oral route, chronic, confirmed non-exposures, or not followed to outcome were excluded.
Results: A total of 2715 encounters were reviewed, and 808 encounters were included for analysis. Overall clinical outcomes for all 808 encounters included 6 (0.7%) major effect, 49 (6.1%) moderate effect, 154 (19.1%) minor effect, and 599 (74.1%) no effect. The most common scenarios included 225 inadvertently taking a double dose, 62 doses taken too close together, 60 inadvertently taking someone else's medications, 50 wrong medication taken, and 12 iatrogenic errors. Of the 225 double dose scenarios, 215 (95.6%) of them were either minor (17.3%) or no effect (78.2%). Reasons for ingestion were 71 (8.8%) intentional and 737 (91.2%) unintentional. There were no fatalities. Outcomes for intentional ingestions were 2 (2.8%) major effect, 13 (18.3%) moderate effect, 31 (43.7%) minor effect, and 25 (35.2%) no effect. Outcomes for unintentional ingestions were 4 (0.5%) major effects, 36 (4.9%) moderate effects, 123 (16.7%) minor effects, 574 (77.9%) no effect. Of the 213 encounters for patients younger than 5 years there were 0 major effects, 2 (0.9%) moderate effects, 24 (11.3%) minor effects, and 187 (87.8%) no effect. The top 5 most frequent clinical effects were vomiting ($n = 65$), nausea ($n = 58$), abdominal pain ($n = 26$), diarrhea ($n = 25$) and hypertension ($n = 22$). Two patients were intubated and admitted to a critical care unit.
Conclusions: This is the largest study to date describing 21 years of experience with acute OATA ingestions reported to US Poison Centers. Overall 93.2% of clinical outcomes were either minor or no effect. The majority of unintentional exposures experienced minor or no clinical effect, while those with an intentional ingestion experienced 21.1% moderate or major effects. Home management should be considered for asymptomatic patients with unintentional ingestions. This study is limited by its retrospective nature and reliance on caller information.

KEYWORDS Oral anticancer targeted agent; ingestion; antineoplastics

laurenehwells@gmail.com

106. Utilization of the medical toxicologist consultation by health care facilities through poison centers

Lesley Pepin[a], William Boroughf[b], Daniel Spyker[c] and Christopher Hoyte[d]

[a]Denver Health, Denver, CO, USA; [b]University of Colorado, Aurora, CO, USA; [c]Oregon Health and Science University, Camas, WA, USA; [d]Rocky Mountain Poison and Drug Center, Denver, CO, USA

Background: Medical toxicologists' expertise is most important in the management of the complicated, sick poisoned patient. Often the nuances of poisoning care can impact patient outcomes, allocation of resources and education of the managing medical team. Medical toxicologist involvement may be guided by poison center (PC) protocol. Often, it is driven by bedside provider discretion and request. Continuing to improve this system requires an understanding of the case features that are associated with medical providers requesting a medical toxicology consultant. The aim of this study was to determine the case features most associated with medical toxicologist involvement in a poison center case.
Methods: We retrospectively reviewed cases reported from health care facilities to a large, US PC from January 1, 2015 through December 31, 2021. Cases with known effects related to poisoning were included (minor, moderate, major effect or death). Case features evaluated included: age, gender (male, female, pregnant), number of substances, health care facility (urban, rural or critical access hospital), reason for exposure (simplified to intentional, unintentional, adverse reaction, withdrawal, other-malicious and contamination, or unknown), highest level of care, medical outcome, hospital transfer, use of antidote, count of critical care therapies used. Bivariate analyses and stepwise logistic regression identified variables most strongly associated with medical toxicology consultation via SAS JMP (v 16.0.0).
Results: There were 101,654 cases originating from health care facilities during the study period and 87,562 cases met inclusion criteria. We excluded cases with missing data leaving 86,268 cases for our study. There were 49,577 (57%) females, median age 25 years (IQR 26). There were 11,370 (13%) cases involving a medical toxicologist consult. Consults were most common with urban hospital cases (14%) and least common with critical access

(9%) and rural hospitals cases (9%). Across medical outcomes, consults were highest for cases with outcomes of death (70%) and major effects (42%). In the multivariate analysis, features most associated with medical toxicologist consultation included level of care, medical outcome, hospital transfer, antidote therapy use, health care facility, gender, substance count, age, count of critical care therapies.
Conclusions: Medical toxicologist involvement was not unusual for cases reported in this study. Consultations seem to be appropriately associated with sicker more complex patients requiring admission, antidotal or critical care therapies. Interestingly, pregnancy and younger age were both associated with increased consultation, likely reflecting conservative management in these higher risk populations. While these findings are expected, improving PC processes to facilitate consultation could be guided by these case features. Also, there is room for improvement in consultation use. In major effect and death outcomes, 53% did not involve a medical toxicologist consultation. Similarly, 62% of cases requiring critical care therapies did not involve a medical toxicology consultation. Making these services readily available and streamlined would likely improve use in cases that require it most.

KEYWORDS Medical toxicologist; poison center; consult services

lesley.pepin@rmpds.org

107. Bupivacaine overdose associated with bupivacaine/baclofen intrathecal pump malfunction: a case report

Reba Hodge, Aaron Tyagi, Matthew Blackburn, Michael Behal and Andrew Micciche

University of Kentucky, Lexington, KY, USA

Background: Bupivacaine, an amide local anesthetic, is commonly used in intrathecal infusion pumps for spastic disorders. Pump malfunctions place patients at risk of bupivacaine overdose which can manifest as local anesthetic systemic toxicity (LAST). Here, we report a case of LAST secondary to bupivacaine/baclofen pump malfunction requiring treatment with lipid emulsion due to refractory hemodynamic instability.
Case report: A 24-year-old male with cerebral palsy and right-sided spastic hemiparesis with intrathecal (IT) bupivacaine/baclofen pump in place presented from clinic with weakness, numbness, dyspnea, and somnolence. The patient had experienced a pump malfunction in clinic with unknown amount of bupivacaine or baclofen extravasation into the subcutaneous space. The patient's initial Glasgow Coma Score (GCS) was 10, however 4 min after arrival he decompensated to a GCS 3 requiring intubation. He remained persistently hypotensive (systolic blood pressure 77–97 mmHg) and bradycardic (heart rate 40–45 beats/minute (bpm)), and hemodynamic support was initiated. Needle aspiration was performed to remove 14 mL of extravasated drug. Toxicology was consulted due to concern for LAST from bupivacaine overdose. The patient's heart rate remained 37–42 bpm, therefore intravenous lipid emulsion (ILE) therapy with 20% lipid emulsion was begun for refractory hemodynamic instability. The patient was given an initial bolus of 1.5 mL/kg over 1 min followed by a continuous infusion of 0.25 mL/kg/min with good initial response in heart rate and blood pressure. Atropine 1 mg was also administered due to a significant bradycardic episode. ILE was held after 1200 mL total of 20% lipid emulsion had been infused and the patient remained hemodynamically stable. He no longer required vasopressor support by day 2. He remained intubated and sedated with a midazolam continuous infusion to manage potential baclofen withdrawal until his bupivacaine/baclofen pump was surgically replaced on day 4. Following replacement, he was weaned from sedation and extubated on day 5, subsequently transferred to the floor, and ultimately discharged to an acute rehabilitation facility on day 8.
Discussion: Our patient presented with a clinically significant overdose of bupivacaine and baclofen secondary to IT pump malfunction, and his presentation was consistent with LAST. LAST occurs due to excessive sodium channel blockade in myocardial cells. Bupivacaine is associated with worse cardiotoxicity than other local anesthetics due to enhanced carnitine acetyltransferase inhibition and decreased fatty acid transport, evidenced by the persistent hemodynamic compromise seen in this patient. In the setting of LAST, ILE works by sequestering lipophilic anesthetics in a lipid phase, preventing interaction with target receptors, and promoting drug elimination. ILE also provides fatty acid energy for myocardial cells to utilize.
Conclusions: The patient's prompt response to ILE therapy supports the diagnosis of LAST. The subcutaneous extravasation seen in this case has not been reported in the literature and presented a unique aspect of management. There are few reports of LAST due to IT pump malfunction with bupivacaine overdose, and our report highlights the importance of prompt identification, pump interrogation, source control of drug depot, and hemodynamic stabilization with ILE therapy.

KEYWORDS Bupivacaine; LAST; intrathecal

Raho226@uky.edu

108. Additional findings in ED patients intubated for ethanol and other critical intoxication: a review of head CT imaging and other xenobiotic exposures

Lauren Harvey[a], Gabbie Gervais[a], Jon Cole[b], Travis Olives[b,c], Matthew Prekker[b] and Brian Driver[b]

[a]University of Minnesota Medical School, Minneapolis, MN, USA; [b]Hennepin Healthcare, Minneapolis, MN, USA; [c]Minnesota Poison Control System, Minneapolis, MN, USA

Background: Substance use and acute intoxication are significant sources of illness and healthcare utilization in the US. The number of ED visits related to ethanol use increased by over 50% from 2006 to 2014. Similar trends among ED presentations due to other intoxicants, including opioids and methamphetamine, have been observed. Many of these patients require intubation, compromising neurologic examination and assessment. A clinical question persists regarding the need to obtain brain imaging to screen for occult intracranial bleeding in patients intubated for presumed intoxication. We sought to determine the rate of head CTs positive for acute abnormalities in non-suicidal patients prospectively identified as requiring intubation for ethanol intoxication compared to patients intubated for presumed intoxication from other substances.
Methods: A single-center evaluation of adult patients intubated for acute non-suicidal intoxication at a safety-net emergency department between January 2020 and January 2022 was performed. The project was prospectively identified as departmental quality improvement. At the time of intubation, resident or attending physicians completed a questionnaire regarding the clinical impression of patient presentations, including suspected intoxicant/substance use and indications for intubation. Data regarding the patients' prehospital interventions and subsequent care were later collected from the electronic record, including head CT (HCT) findings and urine drug testing results. All urine drug testing at the study institution consists of 14 immunoassays

followed in real time by liquid and/or gas chromatography with mass spectrometry.
Results: During the study period 246 patients were intubated for non-suicidal intoxication, 76 for suspected pure ethanol intoxication (etoh) and 170 for suspected other (etoh+) intoxication. Median age was 35 (IQR 27–51) and 33.5 (IQR 28–43) years for etoh and etoh + groups, respectively. Median measured blood ethanol concentration (BAC) was 258 mg/dL (0–617) for etoh and 0 mg/dL (0–519) for etoh+. 40 (52%) etoh patients and 154 (90.6%) etoh + patients had urine drug testing completed. Among etoh patients, 7 (17.5%) were positive for a xenobiotic, 6 (85.8%) for a known CNS intoxicant. Among etoh + patients, 123 (81.2%) were positive for a xenobiotic, 100% of which were positive for a known CNS intoxicant (Fisher's exact test =0.054 for comparison between groups). he most frequent being amphetamines, methamphetamine, fentanyl, cocaine, and benzodiazepines. Among the etoh group, 61 patients (80.3%) underwent HCT. 7 (11.5%) of these were positive for acute intracranial pathology. By comparison, 137 etoh + patients (80.6%) underwent HCT, and 3 (2.2%) were positive for acute pathology ($p = 0.011$, Fisher's exact test for comparison between groups), described in Table 2. Among all patients found to have acute intracranial pathology on head CT, 7 (70%) were suspected or known to have sustained a traumatic injury.
Conclusions: Patients intubated for suspected ethanol intoxication appear to be at higher risk for acute intracranial pathology than those intubated for other xenobiotic intoxication; the role of trauma in this difference appears substantial.

KEYWORDS Alcohol intoxication; intracranial pathology; additional xenobiotic

harve270@umn.edu

109. Self-treatment of gastrointestinal side effects from off-label ivermectin use with oral sodium bicarbonate causing gastric perforation and profound electrolyte derangement

Anna Williams[a] and Ryan Marino[b]

[a]Department of Emergency Medicine, University Hospitals Cleveland Medical Center, Cleveland, OH, USA; [b]University Hospitals Cleveland Medical Center and Case Western Reserve University School of Medicine, Cleveland, OH, USA

Background: Ivermectin is a commonly prescribed antiparasitic medication. Ivermectin has a large margin of safety in humans, however, it has common side effects at therapeutic dosing, namely gastrointestinal upset such as nausea, vomiting and diarrhea. Despite a lack of efficacy or evidence to support its use, ivermectin has been widely used off-label during the COVID-19 pandemic for proposed prophylaxis and treatment of infections caused by the SARS-CoV-2 coronavirus. The doses and durations used in these regimens are not based in any peer-reviewed evidence and vary widely. Proponents of this off-label use often cite its safety profile, however, toxic effects have been well-documented.
Case report: This is a single patient case report. A 61-year-old woman weighing 45.5 kg with no known past medical history presented to the emergency department after she collapsed in front of family. She reported generalized weakness, greater than 35-kilogram weight loss over an 8-month period and chronic nausea, vomiting and diarrhea. Her gastrointestinal symptoms began first after she was prescribed ivermectin for COVID-19 prevention 8 months before this presentation. The directions were to take 18 mg (approximately 396 mcg/kg) once daily for 5 days and then 18 mg once weekly for 12 months, however, she stated she had been taking additional doses. She stated that the ivermectin made her nauseated and she believed was causing her to have acid reflux, so she also ingested "spoonfuls" of baking soda mixed in water, multiple times daily, for those symptoms over the 8 month time period. At presentation, she was found to have profound metabolic alkalosis with pH 7.55 and serum bicarbonate 60 mmol/L, hypokalemia (serum potassium 1.7 mmol/L), hypocalcemia (ionized calcium 1.05 mmol/L), hypophosphatemia (serum phosphorous 1.8 mg/dL) and hypochloremia (serum chloride 87 mmol/L). Computed tomography imaging of her abdomen and pelvis demonstrated bowel pneumatosis and free air requiring transfer to tertiary care facility for exploratory laparotomy with finding of gastric perforation requiring post-pyloric feeding tube placement. She required 4 days in the intensive care unit and was discharged to home on hospital day 38.
Discussion: Ivermectin is a typically well-tolerated anti parasitic that has known gastrointestinal side effects. This patient was given a high-dose prescription for 12 months with no evidentiary basis behind the dose, length or indication. In her own assessment she attempted to self-treat the medication side effects with chronic ingestion of sodium bicarbonate, which caused severe metabolic derangements and was thought to have caused her gastric perforation and pneumatosis. While this dose did not cause direct ivermectin toxicity, its side effects caused patient-directed therapy leading to significant harm.
Conclusions: Ivermectin is a commonly prescribed drug with a large safety margin but with well-documented side effects. Although there is no current indication for its use for the prevention or treatment of COVID-19 it has been widely used for that purpose in unconventional doses and duration, and this practice carries risk of patient harm.

KEYWORDS Ivermectin; COVID; bicarbonate

Anna.Williams@uhhospitals.org

110. Clinical presentation of 149 African elapid envenomations at a rural snakebite clinic in Kindia, Guinea

Jordan Benjamin[a], Mamadou Cellou Balde[b] and Nicklaus Brandehoff[c]

[a]Asclepius Snakebite Foundation, Walla Walla, WA, USA; [b]Institut de Recherche en Biologie Appliquée de Guinée, Kindia, Guinea; [c]Toxicology Associates, Littleton, CO, USA

Background: Envenomations by neurotoxic African elapid species pose unique challenges for clinicians working in West Africa. These cases are complicated by significant knowledge gaps concerning the pathophysiology of envenomation syndromes and the most appropriate treatment modalities in low-resource settings where these bites can account for over 70% of snakebite mortalities.
Methods: A retrospective chart review was completed, which included 149 patients presenting to a clinic in Kindia, Guinea within 7 days of envenomation by African mambas or cobras between January 2017 and October 2020 as part of the African Snakebite Registry (ASR). Elapid envenomations were identified based upon either (1) identification of the snake responsible for the envenomation when a physical specimen was provided or (2) the presence of pathognomonic symptoms of neurotoxic African elapid envenomation
Results: During this 4-year period, 149 neurotoxic envenomations were identified, with 55% ($n = 82$) being male and 45% ($n = 67$) being female. Snakes species in the region resulting in neurotoxic syndromes include *Dendroaspis polyepis*, *D. viridis*, *Naja savannula*, *N. guineensis*, *N. katiensis*, and *N. nigricolis*. Principal features of the neurotoxic syndrome included ptosis (37%), dyspnea (15%), aphasia

(12%), and altered mental status (17%). More than half of all patients suffering from elapid bites also presented with hemotoxic signs in the form of either coagulopathy (60%) as assessed using the beside whole blood clotting test or the presence of persistent, atraumatic local bleeding (44%) from the bite wound for >30 min after the bite. Gastrointestinal signs such as active vomiting were noted in 24% of patients. Hypersecretions were documented in 24% of cases. *Dendroaspis* species required more than twice the antivenom dose than *Naja* species (LD50 1750 versus 800). There were 21 fatalities (14%).

Conclusions: The high incidence of neurotoxic envenomations treated at the clinic is unusual for this region. Despite substantial advances in antivenom development and other clinical treatments, neurotoxic snakebites remain the most poorly understood syndrome of snake envenomation and are associated with significantly higher mortality rates. Death due to direct effects of the venom has been reported as early as 15 min after a bite, though it is more commonly seen in the first 2–24 h. The poor infrastructure in this region creates significant barriers and patients with neurotoxic envenomations that occur several hours from the clinic are likely to die prior to arrival. The prevalence of local bleeding and coagulopathies due to envenomation by African elapids is unique. The concomitant presentation of neurotoxic and hemotoxic effects is characteristic of envenomations by Australasian elapids but is rarely seen and reported in African elapid envenomations. Bleeding and coagulopathy were documented in over 50% of all patients presenting with elapid bites and occurred in cases of envenomation by mambas, neurotoxic cobras, and spitting cobras. The prevalence of these findings and the diversity of species involved warrants additional investigation by multidisciplinary teams of herpetologists, venomic experts, and clinicians to help determine this significant finding.

KEYWORDS Snakebite; envenomation; Africa

jordan@snakebitefoundation.org

111. Characterization of eastern coral snake exposures managed by the Florida Poison Information Center Network

Chiemela Ubani[a], Molly Stott[b], Dawn Sollee[c], Jay Schauben[c], Alexandra Derr[d], Amanda Hammond[e], Colleen Cowdery[d], Lindsay Schaack Rothstein[f], Ashton Federico[d], Gerard Garvan[g] and Sophia Sheikh[h]

[a]Florida Poison Information Center- Jacksonville, Jacksonville, FL, USA; [b]FL/USVI Poison Information Center, Jacksonville, FL, USA; [c]Florida/USVI Poison Information Center-Jacksonville, Jacksonville, FL, USA; [d]UF Health Shands Jacksonville, Jacksonville, FL, USA; [e]Georgia Poison Center/Grady Health System, Atlanta, GA, USA; [f]Florida/USVI Poison Information Center – Jacksonville, Jacksonville, FL, USA; [g]UF Health Shands, Gainesville, FL, USA; [h]Florida USVI Poison Information Center, Fernandina Beach, FL, USA

Background: Traditionally, the North American Coral Snake Antivenom (NACSA) has been administered empirically after a suspected coral snakebite. However, due to a shortage, the treatment paradigm shifted to a "wait-and-see" (WaS) approach, with NACSA given at the first sign of systemic toxicity. Recently, the availability of NACSA has improved and the original protocol returned to standard practice. There is limited research available comparing the two treatment paradigms (empiric vs WaS) to determine if one is associated with improved patient outcomes. The objective of this study is to compare medical outcomes for these two treatment approaches.

Methods: This was an IRB-approved retrospective analysis of coral snake cases reported to the Florida poison Information Center Network (FPICN) from January 1, 1998 to September 3, 2015. Exposure calls in patients, ages 0–100, coded with an AAPCC generic code relating to "coral snake" species or coral envenomation were included. Exposures were excluded if the bite was not by a coral snake, if snake bite management did not complete a 24 h monitoring window., and if associated with AAPCC/NPDS medical outcome codes of not followed, unable to follow, exposure probably not responsible for effect. Demographic, clinical, and outcome variables were collected. Comparisons were made between asymptomatic patients receiving empiric antivenom therapy (152, 35%) and asymptomatic patients who received antivenom upon developing signs of systemic envenomation (WaS) (114, 26%). Severe adverse events to antivenom are defined as: anaphylaxis, angioedema, and systolic blood pressure <100 mmHg. Data were checked for missing elements and irregularities with frequency tables and histograms for nominal variables and numeric variables, respectively. ICU and hospital admittance were modeled using zero-inflated negative binomial regression, to account for overdispersion from length of stay (LOS) having numerous zero values. Age, gender, if the bite occurred during period of antivenom shortage, and if systemic symptoms ever developed (and not just at the time of antivenom administration) were used as control variables in the regression models. All statistical analysis were performed in R 4.1.

Results: Four hundred and forty exposures were analyzed. Of these, 86% (379) were males, the average age was 33. Fifty-three percent were bitten on the finger. Of the WaS group, 13% (15) eventually received antivenom. Twenty percent (30) of the empiric treated group developed adverse reaction to antivenom and 26% (8) had a severe adverse event. Patients in the empiric group had a 3 times higher likelihood of ICU admission (OR 3.1, $p =< 0.0001$) and higher likelihood of a longer hospital admission ($p = 0.0002$) compared to the WaS group. There was no difference in the incidence of intubation, however overall incidence was quite low (3) with two patients intubated as an adverse event post antivenom administration. No difference in adverse events or in ICU LOS between the two groups. Most commonly, patients reported to have experienced pain (41.1%), paresthesia (31.8%), nausea (15.1%).

Conclusions: Empiric modality was associated with higher ICU admissions and antivenom was associated with a considerable risk of adverse reactions which may serve to impose caution when treating empirically.

KEYWORDS Coral snakes; envenomations; snake bites

ubani@poison.ufl.edu

112. A bad rake: intrathecal baclofen in the management of generalized tetanus

Stephen Thornton[a], Elizabeth Silver[a], Tony Rianprakaisang[b], Travis Langner[c] and Hammad Ganatra[c]

[a]Kansas Poison Control Center, Kansas City, KS, USA; [b]Department of Emergency Med, University of Kansas Med Center, Kansas City, KS, USA; [c]Department of Pediatrics, University of Kansas Health System, Kansas City, KS, USA

Background: Generalized tetanus from *Clostridium tetani* infections is rare in the US due to wide spread use of tetanus toxoid-containing vaccines. However, this potentially fatal infection is still seen in unvaccinated populations. Management of these critically ill patients can be challenging and require multiple

pharmacological agents. We report a case of generalized tetanus which was treated with multiple sedative and paralytics but appeared to stabilize with initiation of intrathecal baclofen.
Case report: A 16-year-old unvaccinated male suffered a puncture wound to his left heel when he stepped on a rake. Initially, Burdock leaves and bread mold was used for home wound treatment. After 1 week he presented to a rural hospital with trismus, difficulty swallowing, and autonomic instability. He received 250 IU of TIG and was transferred to a PICU. On arrival he was intubated for airway protection. Medical toxicology was consulted. On hospital day (HD) 1, he was taken to the operating room for wound debridement, received another 500 IU of TIG, metronidazole, cefepime and Tdap vaccination. By HD 3, his conditioned worsened, requiring norepinephrine, esmolol and increasing doses of multiple sedatives (midazolam, morphine, propofol, magnesium). On HD 6, he required constant paralysis with vecuronium and additional sedative (dexmedetomidine). Intrathecal baclofen was recommended by the toxicology service. Oral baclofen was started on HD 11 but he continued to require vecuronium and multiple sedatives. Use of botulinum toxin was discussed but not initiated. Dantrolene was started on HD 16 without improvement. On HD 18, baclofen at 2 mcg/h was started via an intrathecal catheter. Twenty-four hours later, vecuronium was discontinued and multiple sedatives were titrated down. Oral lorazepam and methadone were initiated. By HD 29, intrathecal baclofen was titrated to 7 mcg/h, all IV sedatives except dexmedetomidine were stopped and he was extubated. By HD 33, all intravenous sedatives were discontinued. The intrathecal baclofen was titrated off by HD 35. He was discharged on hospital day 40 with methadone, lorazepam, and clonidine taper. He did receive Td vaccine a month after his TDAP but family refused any further vaccination.
Discussion: *Clostridium tetani* is gram-positive, endospore forming, obligate anaerobic bacteria that is universally present in soil. It elaborates tetanospasmin which locates to presynaptic inhibitor neurons via retrograde transport and results in the destruction of VAMP2/synaptobrevin and inhibits the release of inhibitory neurotransmitters (i.e., glycine). This loss of inhibition results in uncontrollable muscle contractions and autonomic instability. Generalized tetanus has become a rare disease in countries with high vaccination rates but, as in this case, can still occur in any unvaccinated individuals. Treatment is challenging due to the severity and duration of the disease. Benzodiazepines and paralytics are the cornerstone of treatment, but prolonged use can lead to iatrogenic complications. Use of baclofen, a GABA-B antagonist, via the intrathecal route has been previously reported in some case reports. In this case, initiation of the intrathecal baclofen was temporally related with a significant de-escalation of other pharmacological therapies.
Conclusions: Intrathecal baclofen is a potential treatment for generalized tetanus which may allow for reduction in paralytic and sedative use

KEYWORDS Tetanus; baclofen; intrathecal

sthornton@kumc.edu

113. Effects of legalization of cannabis on use practices and comorbid drug use from a nationally representative, cross-sectional survey of drug use in adults in the US

Joshua Black, Elise Amioka, Janetta Iwanicki, Richard Dart and Andrew Monte

Rocky Mountain Poison and Drug Safety, Denver Health and Hospital Authority, Denver, CO, USA

Background: Policies related to increasing cannabis use, possession, and sales have varied widely from prohibition to recreational sale legalization. Differences in policy can have impacts on the prevalence of cannabis use, reasons for use, and comorbid drug use behavior. Our objective was to compare cannabis use by state-level legalization status, testing two primary hypotheses: (1) legalization increases the prevalence of use, and (2) legalization increases use to treat medical conditions but not other reasons.
Methods: This was a retrospective cross-sectional study using an online nationally representative survey. The survey was administered in 3 waves from September 2018 to November 2019. Participants were the general adult population in the US, weighted for national representativeness. State-level cannabis legalization status was the main exposure variable of interested: recreational states, where defined as states with both recreational and medical dispensaries; medical-only states where active medical cannabis dispensaries were open; and non-legal states with no legal dispensaries. The primary outcome was prevalence of self-reported cannabis use.
Results: The survey was administered to 89,444 adults, which estimated an average annual population of 253 million adults. Past 12-month cannabis use prevalence increased significantly as cannabis availability increased: no legal cannabis 14.38% (95% CI:13.13, 15.64), medical cannabis 16.3% (95% CI:15.99, 16.62), and recreational cannabis respectively 26.92 (95% CI:26.17, 27.68), ($p < 0.0001$). Problematic drug use, represented by Drug Abuse Screening Test (DAST-10) scores of 3 or greater, were higher amongst cannabis users compared to non-users, but odds ratios (OR) were lower in recreational cannabis (OR:11.6, 95% CI: 10.0–13.5) states compared to non-legal states (OR:16.1, 95% CI: 11.4–22.8). Among cannabis users, there was no differences across legalities in using cannabis to treat a medical condition nor to get high. While opioid use did not differ across states, adults using both cannabis and opioids were more likely to endorse using opioids to get high in recreational cannabis states (30.13% [95% CI: 27.14, 33.11]) compared to non-legal (23.72 [95% CI: 17.71, 29.72]) or medical only cannabis states (26.42 [95% CI: 24.96, 27.88]).
Conclusions: Cannabis legalization is associated with a doubling of cannabis use prevalence and increased problematic drug use practices among users. However, legal recreational cannabis is associated with a lower risk of overall comorbid drug use. Assessment for comorbid substance abuse and intervention when appropriate is necessary for cannabis users.

KEYWORDS Cannabis; comorbid drug; legalization

joshua.c.black@cuanschutz.edu

114. Google Trends pattern of ivermectin Google searches during the COVID-19 pandemic

Kelly Hogue[a] and Mathias Forrester[b]

[a]North Texas Poison Center, Midlothian, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Ivermectin is approved by the US (US) Food and Drug Administration (FDA) to prevent or treat internal or external parasites in humans. It is also used for pets and livestock. There is insufficient evidence to support the use of ivermectin in the prevention or treatment of COVID-19. In spite of this, people sought and used both human and veterinary formulations of ivermectin during the COVID-19 pandemic. Both the number of human ivermectin prescriptions and ivermectin exposures reported to poison centers in the US increased in January 2021

and then increased even further in July 2021. Ivermectin use may result in nausea, vomiting, diarrhea, confusion, hallucinations, ataxia, seizures, coma, and hypotension. The objective of this study was to describe the pattern of internet searches for ivermectin during the COVID-19 pandemic.
Methods: Google Trends (www.google.com/trends) analyzes a subset of worldwide Google web searches from all Google domains. A search term or keyword is entered on the website. Google Trends then computes how many searches have been performed for the search term relative to the total number of searches performed on Google. This does not provide absolute search volume numbers. Instead, data are normalized. Each data point consists of the number of searches for the term of interest divided by the total searches and the data are scaled on a range of 0–100. On January 2, 2022, a Google Trends search was performed for the term "ivermectin" for the period January 6, 2019–January 1, 2022, and the geographic area of the US. The scale values by week and by geographic region were examined.
Results: From January 6, 2019 to February 29, 2020 (the period prior to declaration of the COVID-19 pandemic), the mean weekly scale value was 1 (range 1–2). From March 1, 2020 to December 5, 2020 (approximately the first 9 months of the COVID-19 pandemic), the mean weekly scale value increased slightly to 3 (range 1–22). Starting on December 6–12, 2020, the weekly scale values began to increase, reaching a peak of 23 during December 13–19, 2020, before declining. During February 14–June 19, 2021, the mean weekly scale value was 7 (range 4–9), higher than before the increase in scale values. During June 20–26, 2021, the scale values began to rise again, reaching a maximum peak of 100 on August 29–September 4, 2021, before falling once more to a scale value of 16 during November 21–27, 2021, before rising again to a scale value of 32 during December 25, 2021–January 1, 2022. The mean scale value by region was Northeast (42, range 34–56), Midwest (53, range 40–67), South (59, range 34–100), and West (62, range 42–94).
Conclusions: Google searches for the term "ivermectin" experienced a first, smaller surge in December 2020-February 2021 and a second, larger surge in July–September 2021. This pattern was similar to that observed for ivermectin prescriptions and exposures reported to poison centers in the US during comparable time periods. The mean scale value was lowest in the Northeast and highest in the West.

KEYWORDS Google; ivermectin; COVID-19

kelly.hogue@phhs.org

115. Impact of a new toxicology consult service in a large tertiary care teaching hospital

Miguel Glatstein[a], Efrat Zandberg[a], Dennis Scolnik[b] and Christopher Hoyte[c]

[a]Sorasky Medical Center, Tel Aviv, Israel; [b]Sick Children's Hospital, Toronto, Canada; [c]Rocky Mountain Poison and Drug Center, Denver, CO, USA

Background: The subspecialty of medical toxicology is not widely available in Israel: there are only a limited number of toxicologists and toxicology services available for consultation. In collaboration with the Tel Aviv Sourasky Medical Center, an Israeli-certified pediatric emergency physician was sent to complete an international medical toxicology fellowship program at the Rocky Mountain Poison Center in Denver, Colorado, USA. Following the physician's return, a medical toxicology consultation service was established in September 2017, focusing on in-person consultations which had not previously been available. This study aimed to describe and evaluate this new medical toxicology service and to document challenges that may be encountered by such an endeavour.
Methods: From September 2017 to December 2021, 1703 toxicology consultations were conducted.
Results: The most common exposures and reasons for consultation were: psychotropic medications (427, 23%), analgesics and anti-inflammatory medications (353, 19%), household products (312, 17%), substance of abuse (240, 13%), and natural toxins (142, 8%). In-person medical toxicology consultations were performed in 1036 cases (62%), during both daytime and night shifts. The number of consultation requests increased steadily during the study period, highlighting the required culture change in an institution's transition to an in-person consultation service.
Conclusions: Training healthcare professionals in toxicology is important and can lead to significantly improved patient outcomes.

KEYWORDS Medical toxicology; poison center; fellowship

nopasara73@hotmail.com

116. Paint inhalation abuse and misuse reported to poison centers

Alexander Casanova[a], Mathias Forrester[b], Brett Roth[a,c] and Pablo Frias de la Cruz[a]

[a]North Texas Poison Center, Dallas, TX, USA; [b]Independent Researcher, Austin, TX, USA; [c]UT Southwestern Dallas, Dallas, TX, USA

Background: Paint, particularly spray paint, may be inhaled for recreational intoxication. The adverse effects of paint inhalation depend on the type of paint inhaled; common ingredients of spray paint are acetone, xylene, liquefied petroleum gas, n-butyl acetate, and methyl ethyl ketone. Clinical effects reported with paint inhalation include itchy or burning eyes, nasal and throat irritation, skin irritation, nausea, headache, dizziness, confusion, drowsiness or lethargy, fatigue, hallucination and delusions, and lack of coordination. The objective of this study was to describe paint inhalation abuse and misuse reported to poison centers.
Methods: Cases were exposures to paint (Generic codes 0077202, 0077685, 0254000, 0254365, 0254366, 0254368, 0254369, 0254370) reported to the National Poison Data System (NPDS), a database that receives data from all US poison centers, during 2000–2020 where the exposure route was inhalation and the exposure reason was intentional abuse and intentional misuse. The distribution of total cases was determined for patient demographics and exposure circumstances. The distribution of cases not involving other substances was determined for management and outcome.
Results: Of 3234 total cases, 2415 (74.7%) were intentional abuse and 819 (25.3%) were intentional misuse. The annual number of cases increased from 227 in 2000 to 251 in 2002 then decreased to 74 in 2020. The patient age distribution was 8 (0.2%) 0–5 years, 193 (6.0%) 6–12 years, 894 (27.6%) 13–19 years, 649 (20.1%) 20–29 years, 595 (18.4%) 30–39 years, 419 (13.0%) 40–49 years, 296 (9.2%) 50 years and older, and 180 (5.6%) unknown age; 2285 (70.7%) of the patients were male, 937 (29.0%) female, and 12 (0.4%) unknown gender. The exposure site was 2485 (76.8%) patient's own residence, 175 (5.4%) public area, 101 (3.1%) other residence, 66 (2.0%) school, and 407 (12.6%) other and unknown locations. No other substances were reported in 2521 (78.0%) of the cases. Of these 2521 cases, 1462 (58.0%) of the patients were already at or en route to a healthcare facility, 414 (16.4%) were referred to a healthcare facility by the poison center, 595 (23.6%) were managed on site, and 50 (2.0%) were managed at other or unknown locations. The medical outcome was 409 (16.2%) no effect, 641 (25.4%) minor effect, 526 (20.9%) moderate effect, 67 (2.7%) major effect, 26 (1.0%) not followed-

judged nontoxic, 425 (16.9%) not followed-minimal clinical effects possible, 314 (12.5%) unable to follow-potentially toxic, and 109 (4.3%) unrelated effect; 4 (0.2%) deaths were reported. A clinical effect was reported in 1795 (71.2%) of the 2521 cases not involving other substances. The most frequently reported clinical effects were drowsiness/lethargy ($n = 344$, 13.6%), confusion ($n = 265$, 10.5%), dizziness/vertigo ($n = 254$, 10.1%), headache ($n = 215$, 8.5%), tachycardia ($n = 214$, 8.5%), nausea ($n = 198$, 7.9%), agitation (n =150, 6.0%), and vomiting ($n = 130$, 5.2%). The most commonly reported treatments were fresh air ($n = 844$, 33.5%), intravenous fluids ($n = 348$, 13.8%), oxygen ($n = 330$, 13.1%), and dilute/irrigate/wash ($n = 323$, 12.8%).
Conclusions: Almost half of the patients were age 13–29 years and the majority were male. Most of the inhalations occurred at home. The majority of inhalations involved only gasoline and did not result in serious outcomes.

KEYWORDS Paint; inhalation; abuse

alexander.casanova@phhs.org

117. Impact of the COVID-19 pandemic on adolescent US poison center exposure calls

George Sam Wang[a], Jan Leonard[a], Anastasia Cornell[b] and Christopher Hoyte[b]

[a]University of Colorado Anschutz Medical Campus, Aurora, CO, USA; [b]Rocky Mountain Poison and Drug Safety, Denver, CO, USA

Background: During the pandemic, reports of adolescent suicide attempts and ideation presenting to pediatric emergency departments are increasing. US poison centers also observed an increase in the proportion of adolescent calls compared with other pediatric age groups during the pandemic. With varying vaccinations rates and spread of emerging virulent strains, the threat of another pandemic surge remains and public health officials and healthcare providers must remain prepared for continued impacts on the adolescent population. The objective of this study was to evaluate trends in characteristics of adolescent PC exposure calls before and during the COVID-19 pandemic.
Methods: This was a retrospective review of US PC exposure calls reported to the American Association of Poison Control Centers National Poison Data System from January 1, 2018 through June 30, 2021 involving patients 13 to 17 years of age. Descriptive data were used including medians and interquartile ranges for non-normally distributed continuous variables. The average for pre-pandemic years (2018–2019) and average during the COVID-19 pandemic (2020 through June 2021) were compared using chi-square. Monthly calls, rate of hospital admission, and rate of severe outcomes (moderate or major effects or death) were evaluated using interrupted time series with segmented regression analysis. Due to autocorrelation, we modeled the data using the AUTOREG function in SAS with the maximum likelihood modeling option (method = mL). In our monthly models, we specified NLAG =13 and used backward elimination to retain autoregressive parameters significant at the 0.05 level. Predicted values for the monthly adolescent calls, rate of hospital admission, and rate of severe outcomes were calculated from the segmented regression models to illustrate linear trends over time. Statistical analyses were performed in SAS (version 9.4, Cary, NC). This project was approved as exempt by the Colorado Institutional Review Board.
Results: For adolescents aged 13–17 years of age, the average annual US PC exposure calls for 2018 and 2019 was 125,640 per year, and from January 1, 2020 through June 30, 2021 there was an average of 130,293 calls per year. During the COVID-19 pandemic, US PC had more adolescent exposure calls managed in a healthcare facility (71.9% vs 67.4%) and requiring admission (27.2%vs 25.7%) during the pandemic. There were more exposures with suicide intent (55.8% vs 48.8%), moderate/major clinical effects (22.8% vs 20.1%) and deaths (0.07% vs 0.05%). Pre-pandemic, monthly calls increased by 30 calls/month; during the pandemic the call rate significantly increased by 204 calls/month ($p < 0.001$). Similarly, the rate and trend of hospital admissions significantly increased ($p < 0.001$).
Conclusions: During the COVID-19 pandemic, US poison centers observed an increase in adolescent suicidal intent exposure calls with more severe outcomes, hospitalizations, and deaths. As surges in the pandemic continue to occur and the behavioral health crisis continues, healthcare providers and public health officials will need to continue to come up with solutions and resources to overcome these challenges.

KEYWORDS Adolescents; COVID; poison centers

george.wang@childrenscolorado.org

118. Pediatric e-cigarette exposures treated at emergency departments

DazChe Cao[a] and Mathias Forrester[b]

[a]UT Southwestern Medical Center, Dallas, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Electronic cigarettes (e-cigarettes) are battery-powered devices that heat a liquid solution that most commonly includes nicotine, flavorings, and other chemicals. E-cigarette exposures are of particular concern for young children. The labeling of and flavoring in e-cigarettes may make them attractive to children. Severe adverse reactions have been reported in children with nicotine doses as low as 2 mg, while solution concentrations may be as high as 100 mg/mL. Symptoms reported with pediatric nicotine exposure include vomiting, tachycardia, tachypnea, hypertension, hypotension, agitation, respiratory depression, and seizures. The objective of this study was to describe pediatric e-cigarette exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. The NEISS database also includes all poisonings and chemical burns to children less than 5 years of age. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify e-cigarette exposures among patients age 0–5 years reported during 2010–2020, records with the letter combinations "cig," "vape," vapi," "nico," "e-liqu," "e liqu," "eliqu," or "juul" in the record narrative were reviewed, and those that appeared to be e-cigarette exposures were included in the study. The distribution of estimated e-cigarette exposures was determined for various factors.
Results: A total of 174 e-cigarette exposures were identified, resulting in a national estimate of 6703 exposures. The estimated annual number of exposures increased from 21 in 2010 to 1741 in 2015 then declined to 669 in 2020. The patient age distribution was 673 (10.0%) < 1 year, 3212 (47.9%) 1 year, 2240 (33.4%) 2 years, 415 (6.2%) 3 years, 163 (2.4%) 4 years, and 0 (0.0%) 5 years; 3660 (54.6%) of the patients were male and 3043 (45.4%) female. The patient race was 4379 (65.3%) white, 249 (3.7%) black/African American, 254 (3.8%) other, and 1821 (27.2%) not stated. The exposure route was 6478 (96.6%) ingestion, 411 (6.1%) dermal, 94 (1.4%) inhalation, 42 (0.6%) ocular, and 6 (0.1%) aspiration. The location of the incident was 5542 (82.7%) home and 1161 (17.3%) not recorded. The most frequently documented clinical effects were 481 (7.2%) vomiting, 80 (1.2%)

cough/choke, and 79 (1.2%) dizziness. The patient disposition was 6302 (94.0%) treated or examined and released, 163 (2.4%) treated and admitted for hospitalization, 139 (2.1%) held for observation, and 99 (1.5%) left without being seegainst medical advice.
Conclusions: Pediatric e-cigarette exposures treated in EDs increased during 2010–2015 and then decreased during 2015–2020. The patients were most often age 1–2 years, and the majority were male. Most exposures occurred by ingestion and the majority occurred at home. Most patients were treated or evaluated and released from the ED.

KEYWORDS E-cigarette; pediatric; nicotine

dazhe.cao@utsouthwestern.edu

119. Intravenous buprenorphine microinduction: a case report

Zachary Illg[a], Nicholas Titelbaum[a], Thao-phuong Hallett[a] and Joseph Carpenter[b]

[a]Georgia Poison Center, Atlanta, GA, USA; [b]Department of Emergency Medicine, Emory School of Medicine, Atlanta, GA, USA

Background: Buprenorphine is a partial mu-opioid agonist that effectively treats both withdrawal symptoms and cravings in patients with opioid use disorder (OUD). Initiation of buprenorphine therapy must be done thoughtfully as premature administration to a patient with recent use of a full mu-opioid agonist may precipitate an opioid withdrawal syndrome. One strategy for initiating buprenorphine in such patients is microinduction, performed by administering low but increasing doses of buprenorphine to gradually occupy mu-opioid receptors, thus avoiding significant withdrawal symptoms. Most microinduction case reports describe the use of sublingual or buccal buprenorphine; there is a paucity of literature concerning the application of intravenous buprenorphine in this scenario. We describe the case of a hospitalized patient with OUD who underwent successful intravenous buprenorphine microinduction.
Case report: A 60-year-old male presented to the emergency department (ED) with a decreased level of consciousness. Upon arrival, he had a GCS of 12 with right-sided deficits. Neuroimaging was significant for an intraparenchymal hemorrhage. His mental status deteriorated while in the ED, prompting intubation for airway protection. Fentanyl and propofol infusions were initiated. On hospital day 3, he was extubated but remained confused with periods of agitation. Collateral information revealed that the patient had a history of daily opioid use. On hospital day 5, his primary care team initiated oral methadone 10 mg three times daily to treat opioid withdrawal. He was maintained on methadone during his hospitalization, and his dose was gradually reduced as he clinically improved. On hospital day 23, the toxicology service was consulted as the patient desired to initiate buprenorphine and follow up with the medication-assisted opioid use clinic affiliated with the hospital. The patient reported a history of prescription opioid misuse and had been using heroin daily for the past year. He met DSM-V criteria for severe OUD. He had never engaged in treatment for his OUD. Given his in-hospital administration of methadone and desire to avoid withdrawal symptoms, it was decided to transition the patient to buprenorphine using a microinduction approach. Sublingual buprenorphine formulations available in the hospital did not allow for a dose lower than 2 mg, therefore an intravenous microinduction was pursued. On day 4 of buprenorphine therapy, methadone was discontinued. The patient was successfully transitioned to sublingual buprenorphine-naloxone, and this was continued throughout his hospitalization at a dose of 8/2 mg twice daily. He did not experience significant opioid withdrawal symptoms during the microinduction.
Discussion: Microinduction utilizing intravenous buprenorphine can effectively transition patients from full mu-opioid agonists to buprenorphine, a partial mu-opioid agonist, without precipitating a significant withdrawal syndrome. Intravenous buprenorphine provides the benefit of precise dose administration, which is a challenge when using sublingual films or tablets, which require being cut or split to obtain small doses for microinduction.
Conclusions: Intravenous buprenorphine microinduction is feasible in the hospital setting. Additional research into the dosing and efficacy of intravenous buprenorphine for microinduction of patients with OUD is needed.

KEYWORDS Microinduction; buprenorphine; opioid use disorder

zac.illg@gmail.com

120. Pediatric tea tree oil exposures treated at emergency departments

Lizbeth Petty[a], Brett Roth[a,b] and Mathias Forrester[c]

[a]North Texas Poison Center, Dallas, TX, USA; [b]UT Southwestern Dallas, Dallas, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Tea tree oil (also known as melaleuca oil) is a volatile essential oil produced by steam distillation of the leaves of *Melaleuca alternifolia*. Tea tree oil is a complex heterogeneous mixture of compounds including 50–60% terpenes. Tea tree oil is used topically to treat skin conditions. It is often used in diffusers, vaporizers, and baths to treat respiratory symptoms. Topical use of tea tree oil may result in irritation and allergic reactions. Tea tree oil may be harmful if ingested. The following adverse effects have been reported from ingestion of tea tree oil: central nervous system depression, ataxia, and lethargy. The objective of this study was to characterize pediatric tea tree oil exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. The NEISS database also includes all poisonings and chemical burns to children less than 5 years of age. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify tea tree oil exposures among patients age 0–5 years reported during 2000–2020, records with the letter combinations "tea tr," "teatr," "tee tr," "teetr," or "melal" in the record narrative were reviewed, and those that appeared to be tea tree oil exposures were included in the study. The distribution of tea tree oil exposures was determined for various factors. Due to the small number of cases, national estimates were not calculated.
Results: Fifty-nine tea tree oil exposures involving patients age 0–5 years were identified. There were 7 (11.9%) exposures during 2000–2006, 17 (28.8%) during 2007–2013, and 35 (59.3%) during 2014–2020. The patient age distribution was 1 (1.7%) < 1 year, 27 (45.8%) 1 year, 22 (37.3%) 2 years, 6 (10.2%) 3 years, 2 (3.4%) 4 years, and 1 (1.7%) 5 years; 32 (54.2%) of the patients were female and 27 (45.8%) male. The patient race was 30 (50.8%) white, 8 (13.6%) black/African American, 6 (10.2%) other, and 15 (25.4%) not stated. The exposure route was 55 (93.2%) ingestion, 2 (3.4%) dermal, and 2 (3.4%) ocular. The location of the incident was 49 (83.1%) home and 10 (16.9%) not recorded. Clinical effects were documented in 10 (16.9%) of the exposures; 2 (3.4%) cases each had chemical burn and vomiting, and 1 (1.7%) case each had altered mental status, ataxia, conjunctivitis, corneal abrasion, dermatitis/rash, difficulty breathing, and lethargy. The patient disposition was 52 (88.1%) treated or examined and released, 5 (8.5%) treated and admitted for hospitalization, and 2 (3.4%) held for observation.

Conclusions: Although rare, pediatric tea tree oil exposures treated in EDs increased during 2000–2020. The patients were most often age 1–2 years, and the majority were female. Most exposures occurred by ingestion and the majority occurred at home. Most patients were treated or evaluated and released from the ED.

KEYWORDS Tea tree; ingestion; pediatric

lizbeth.petty@phhs.org

121. Is hookah swoon-worthy?

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas Health – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Hookahs are water pipes used to smoke flavored tobacco and other substances. The components consist of a bowl, stem, water-filled base, and hose. Tobacco is packed into the bowl, covered with perforated foil or a metal sieve, and heated with charcoal. Inhaling via the hose pulls air past the charcoal, heating the tobacco underneath creating smoke. Then, smoke travels down the stem through the water where cooled smoke fills the base, and, ultimately, is inhaled through the hose. Charcoal is hookah's most common heat source, producing carbon monoxide (CO). Consequently, hookah smokers may be at higher risk of CO poisoning than cigarette smokers. Acute exposures lead to dizziness and headaches; however, prolonged exposures may cause syncope and seizures. The objective of this study was to describe hookah exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 representative US hospitals. National estimates are calculated from database records according to the sample weight assigned to each case based on the inverse probability of the hospital's being selected for the NEISS sample. To identify hookah exposures reported during 2000–2020, records with the letter combinations "hooka," "hukka," "shisha," "boory," "goza," "narghile," "nargile," "arghile," "hubble," or "wat" and "pip" together in the mentioned narrative were reviewed, and those that appeared to be hookah exposures were included. The distribution of hookah exposures was determined for various factors. (Due to the small number of cases, national estimates were not calculated.)
Results: A total of 37 hookah exposures were identified. The first exposure was reported in 2008; 30 (81.1%) were reported during 2014–2020 and 10 (27.0%) during 2020. Nineteen (51.4%) exposures were treated during Saturday–Sunday and 18 (48.6%) during Monday–Friday. Patient age distribution was 10 (27.0%) 16–19 years, 16 (43.2%) 20–29 years, 9 (24.3%) 30–39 years, and 2 (5.4%) 40–47 years; mean age was 26 years (range 16–47 years). Nineteen (51.4%) patients were male, and 18 (48.6%) were female. Patient race was 17 (45.9%) white, 11 (29.7%) black/African American, 1 (2.7%) Asian, and 8 (21.8%) not stated. All exposures occurred by the inhalation route. The location of the exposure was 13 (35.1%) other public property, 10 (27.0%) home, 1 (2.7%) school, 1 (2.7%) place of recreation or sports, and 12 (32.4%) not recorded. Most frequently reported clinical effects were 24 (64.9%) syncope, 16 (43.2%) closed head injury or concussion, 11 (29.7%) dizziness, 10 (27.0%) laceration, and 4 (10.8%) vomiting. Patient disposition was 22 (59.5%) treated or examined and released, 6 (16.2%) treated and transferred to another hospital, 3 (8.1%) treated and admitted for hospitalization, 4 (10.8%) held for observation, and 2 (5.4%) left without being seegainst medical advice.
Conclusions: Although relatively rare, hookah exposures doubled from 2019 to 2020 and have increased rapidly since 2014. Most exposures treated in EDs on the weekends involved adults, males, and syncope. Overall, most patients were treated and released from the ED.

KEYWORDS Hookah; smoke; carbon monoxide

hinojosam4@uthscsa.edu

122. Glaring but not blinding: visible light radiation (laser) exposures reported to poison centers

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas Health – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: "LASER" stands for Light Amplification by the Stimulated Emission of Radiation. Lasers emit nonionizing radiation in the form of visible light by producing a narrow beam of light as monochromatic with low divergence. Laser beams' wavelength, energy content, and pulse features contribute to the hazard classification based on their potential to cause eye and skin injury: the higher the classification number, the greater the hazard risk. Biological effects can range from ocular photothermal injury, including blindness, to dermal injury through photochemical or thermal burns. The objective of this study was to describe visible light radiation (laser) exposures reported to poison centers.
Methods: Cases were exposures reported to the National Poison Data System (NPDS) during 2011–2020, where the exposure involved visible light radiation (laser) [Generic code 0200643). Cases involving other exposures in addition to the light and exposures not followed to a final medical outcome were included. Case distribution was determined for various factors related to patient demographics, exposure circumstances, management, and outcome.
Results: A total of 79 visible light radiation (laser) exposures were identified, of which 77 (97.5%) did not involve other exposures. The patient age distribution was 11 (13.9%) 0–5 years, 8 (10.1%) 6–12 years, 5 (6.3%) 13–19 years, 36 (45.6%) 20 years or older, and 19 (24.1%) unknown age; 34 (43.0%) of the patients were male, 43 (54.4%) female, and 2 (2.5%) unknown gender. The exposure route was 50 (63.3%) ocular, 22 (27.8%) dermal, and 10 (12.7%) other/unknown route. The exposures were 58 (73.4%) unintentional, 3 (3.8%) intentional, 5 (6.3%) adverse reaction, 10 (12.7%) other (malicious), and 3 (3.8%) unknown. Most ($n = 43$, 54.4%) of the exposures occurred at the patient's own residence, 2 (2.5%) at another residence, 10 (12.7%) school, 9 (11.4%) workplace, 13 (16.5%) public area, and 2 (2.5%) at other/unknown locations. The management site was 47 (59.5%) on site, 10 (12.7%) already at or en route to a healthcare facility, 15 (19.0%) referred to a healthcare facility, and 7 (8.9%) at other/unknown locations. The medical outcome was 6 (7.6%) no effect, 7 (8.9%) minor effect, 3 (3.8%) moderate effect, 17 (21.5%) not followed-judged nontoxic, 27 (34.2%) not followed-minimal clinical effects possible, 9 (11.4%) unable to follow-potentially toxic, and 10 (12.7%) unrelated effect; no deaths were reported. A specific clinical effect was reported in 38 (48.1%) of the cases; the most reported clinical effects were ocular irritation/pain ($n = 13$, 16.5%), blurred vision ($n = 9$, 11.4%), headache ($n = 5$, 6.3%), and vomiting ($n = 3$, 3.8%).

Conclusions: Over the 10 years, relatively few visible light radiation (laser) exposures were reported to the NPDS. Most exposures involved females, adults, the ocular route, followed by the dermal route. While nearly all exposures were unintentional, almost 13% were reported as malicious. Although lasers have the potential to cause severe ocular and dermal injury, most exposures reported were managed outside of a healthcare facility and did not result in serious outcomes.

KEYWORDS Laser; nonionizing radiation; visible light

hinojosam4@uthscsa.edu

123. Incidence and outcomes of dogs that develop seizures after 5-FU exposures in 2021

Laura Stern and Tina Wismer

ASPCA Animal Poison Control Center, Urbana, IL, USA

Background: 5-Fluorouracil (5-FU) is an antimetabolite antineoplastic medication used to treat superficial basal cell carcinoma, colorectal cancer, pancreatic cancer, and actinic keratosis in humans, and mammary carcinoma and squamous cell carcinoma in dogs. Seizures are uncommon in humans but are common in dogs. Dogs develop seizures through differences in metabolism. Dogs metabolize 5-FU to fluorocitrate, which causes splitting and vacuolizing myelin and low levels of gamma-aminobutyric acid. The rapid onset of seizures limits the use of vistonuridine, as it must be given prior to the onset of central neurologic signs. Several warning letters have been published urging prescribers to inform patients about the side effects to pets, but exposures are still reported. This study aims to characterize 5-FU exposures to determine the incidence of seizures and potential risk factors for development of seizures.
Methods: The poison control database was queried for 5-FU cases between January 1 and December 31, 2021. Cases represented single, acute dog exposures to 5-FU with clinical signs assessed as high or medium likelihood of being related to the 5-FU exposure. Housemates with a possible exposure with symptomatic housemates were excluded.
Results: 87 cases within the selection criteria were identified. 63/87 (72.4%) became symptomatic. Some asymptomatic dogs may have developed clinical signs that were unreported, as the average last contact was only 3.2 h post exposure and the average onset of clinical signs was 6.3 h post exposure. 43/63 (68.3%) of the symptomatic dogs developed seizures and 5/43 (11.6%) of those dogs who developed seizures died. Dogs that licked a surface that had the product applied (hands, face, pillowcase) or ingested liquid from a leaking IV tube were more likely to remain asymptomatic, likely due to smaller exposures. Dogs that chewed into the ointment tube were more likely to become symptomatic and to have seizures. Dogs that did not develop seizures but did show clinical signs showed similar levels of gastrointestinal upset decontamination to dogs that did develop seizures. Dogs that developed seizures tended to have a higher dosage, show more agitation, and more clinical signs than those dogs who did not develop seizures. The onset of seizures averaged 13.1 h with a range of 1.5–26.85 h post exposure.
Conclusions: Most cases of severe signs had direct exposure to a tube of topical cream. Incidents where the applied cream was licked off human skin or where IV lines were leaking were less likely to show significant signs and did not result in seizures or death. 26.7% of cases were asymptomatic at the time of last contact (3.2 h post exposure). The average onset of any clinical signs was 6.3 h and seizures 13.1 h, it is likely that some of these cases developed clinical signs after the last contact. There is a high incidence of seizures and death following exposure to 5-FU in dogs and any punctured tube should be referred to a veterinary medical facility.

KEYWORDS 5-Fluorouracil; canine; seizure

laura.stern@aspca.org

124. Tiny tokes: trends in pediatric marijuana exposure in upstate New York 2011–2021

Zachary Silberman[a], Michael Hodgman[b,c] and Laura Fil[a,b]

[a]Department of Emergency Medicine, Vassar Brothers Medical Center, Poughkeepsie, NY, USA; [b]Upstate New York Poison Center, Syracuse, NY, USA; [c]Department of Emergency Medicine, SUNY Upstate, Syracuse, NY, USA

Background: As rates of recreational marijuana usage increase, accidental pediatric exposures are increasing as well. More and more regions surrounding New York are legalizing medical and recreational marijuana. Edible forms of marijuana (cookies, gummies, brownies, etc) have a different presentation and duration from inhalational exposures. In light of this, what are the current trends in calls related to marijuana exposure in the pediatric age group?
Methods: This was a retrospective cohort study of calls to the Upstate New York Poison Center Database. We analyzed calls from 2011 to 2021 for ages 0 to 12. From this we extracted calls representative of Marijuana and Cannabidiol exposure by relevant NPDS codes. Out of state calls were excluded. The resultant calls were subdivided by route, management site, and age group to identify descriptive trends.
Results: There were 365 single exposures to marijuana products from 2011 to 2021 for ages 0–12. Of these, the majority were in the 0–6 age group (289) vs the 6–12 age group (76). Ingestion type exposures increased from 2011 to 2021 across all age groups (1–33 in 6–12-year-olds and 2–118 in 0–6-year-olds). Although the total number of inhalational exposures increased from 2011 to 2021 (1 in 2011 and 4 in 2021), this still represented a decreasing proportion of exposures. Regarding calling site, the majority of calls were placed from outside a healthcare facility (208 as compared to 167). Of calls placed outside of a health care facility (HCF), at most 29% presented for management. The remainder of calls were either recommended to be managed on site or refused/lost to follow up for 2017 to 2021. Although commercially available, cannabidiol comprises a small proportion of exposures during this period. The first noted exposures were in 2017 with 6 of 22 total calls increasing to 34 of 158 calls in 2021.
Conclusions: Increases in pediatric exposure correlate with increased rates of legalization in the region surrounding New York. Notably, accidental exposure occurs primarily through ingestion even outside the typical "exploratory" age group. With impending legalization of retail sales, we can predict increased pediatric exposure. As most calls made from outside an HCF are managed outside of an HCF, there is an eminent need for significant investment in public health education related to pediatric marijuana exposures.

KEYWORDS Marijuana; pediatric; accidental

zachary.silberman@nuvancehealth.org

125. Prevalence of substance use disorder patients leaving the hospital against medical advice and subsequent hospital readmissions

Steven Nerenberg and Jackie Johnston
Ernest Mario School of Pharmacy, Piscataway, NJ, USA

Background: Hospitalized patients leave against medical advice (AMA) due to withdrawal symptoms from substance use disorder (SUD). Such incidences contribute to suboptimal patient therapy, leading to increase rates of hospital readmission. Buprenorphine (BUP) prescribed to SUD patients for withdrawal symptom control can prevent them from leaving AMA, thus keeping them in the hospital longer and decreasing hospital readmissions. The purpose of this study is to evaluate the number of patients who leave AMA that have a history of SUD and to determine if patients receiving BUP have reduced hospital readmissions.
Methods: This was an IRB-approved, retrospective cohort study of patients greater than 18 years old who left AMA from June 1st, 2018, to June 1, 2019. The primary endpoint was the incidence of patients discharged AMA with documented SUD in the patient's past medical history. The secondary endpoints were 30-day readmission, 90-day readmission and hospital length of stay (LOS). Descriptive statistics with counts, percent, means, standard deviation, medians and interquartile ranges were used. Chi square was used for nominal data between group statistics and Wilcoxon rank-sum test for continuous data.
Results: A total of 379 patients who left AMA were included. The mean age was 49 ± 15 years, 65% were male and 51% were White. A total of 237 (64%) had a history of SUD. There was no difference in median hospital LOS (3 [IQR: 2–5] vs 3 [IQR: 2–5] days, $p = 0.46$), or 30-day (34% vs 27%, $p = 0.27$) and 90-day (15% vs 12%, $p = 0.44$) readmissions between those with and without SUD. Readmissions with the same primary diagnosis at 30 (51% vs 56%, $p = 0.6$) and 90 days (34% vs 29%, $p = 0.73$) were also similar between groups. For SUD patients who received BUP (34/237), the median hospital LOS was 4 days [IQR: 2–6, $n = 34$] compared to 3 days[IQR: 2–5, $n = 203$; $p = 0.17$] for those who did not. There was no difference in 30-day readmissions for patients that received BUP compared to those that did not (38% vs 33%, $p = 0.5$), but BUP was associated with a higher rate of 90-day readmissions (50% vs. 9%, $p < 0.0001$). Overall, patients who received BUP had fewer readmissions with same primary diagnosis at 30 (8% vs 6%, $p = 0.001$) and 90 days (60% vs. 61%, $p = 0.001$).
Conclusions: Most patients who left AMA during the study period had a history of SUD. Compared with patients with a history of SUD that did not receive BUP, those who did receive BUP had a longer median LOS although this was not statistically significant. Although limited by the small number of patients who received BUP and left AMA during the study time period, patients who did receive BUP were significantly less likely to be readmitted at 30 and 90 days with the same diagnosis. Additional studies with BUP to reduce patients leaving the hospital AMA and subsequent readmission are needed.

KEYWORDS Substance use disorder; buprenorphine; readmissions

steven.nerenberg@pharmacy.rutgers.edu

126. Abstract Retracted by Authors

127. Ivermectin adverse events reported to the food and drug administration

Maximillian Avila[a], Alba Caceres-Munoz[b], Arpan Patel[a], Pablo Frias de la Cruz[a], Satpreet Mandair[a], Amy Young[c] and Mathias Forrester[d]
[a]North Texas Poison Center, Dallas, TX, USA; [b]North Texas Poison Control, Fort Worth, TX, USA; [c]UT Southwestern, Dallas, TX, USA; [d]Independent Researcher, Austin, TX, USA

Background: Ivermectin is approved by the US (US) Food and Drug Administration (FDA) to prevent or treat internal or external parasites in humans. It is also used for pets and livestock. There is insufficient evidence to support the use of ivermectin in the prevention or treatment of COVID-19. In spite of this, people sought and used both human and veterinary formulations of ivermectin during the COVID-19 pandemic. Ivermectin use may result in nausea, vomiting, diarrhea, confusion, hallucinations, ataxia, seizures, coma, and hypotension. The objective of this study was to characterize ivermectin adverse events reported to the US FDA during the COVID-19 pandemic.
Methods: Data were obtained from the FDA Adverse Event Reporting System (FAERS), a national database that contains reports of drug and other biologic product adverse events and medication errors. The FAERS public dashboard was searched for all records received during January 2020-September 2021 that reported ivermectin alone or in combination with other medications. The cases were divided into those that were COVID-19-related (where COVID-19 was mentioned in the Reason for Use or Reactions fields) and all other cases. Cases involving exposures to other substances (mentioned in the Suspect Product Active Ingredients or Concomitant fields) were included in analyses.
Results: Of 138 COVID-19-related ivermectin adverse events (of which COVID-19 was mentioned in the Reason for Use in 133), 36 (26.1%) were reported by a consumer, 87 (63.0%) by a healthcare professional, and 15 (10.9%) by other/not specified. The highest monthly number of reports was received in January 2021 ($n = 29$) and in September 2021 ($n = 29$). Of the 124 cases with known patient sex, 70 (56.5%) were male and 54 (43.5%) female. Of the 89 patients with a reported age, the mean age was 58 years (range 20–85 years). No other substances were reported in 52 (37.7%) of the cases. The adverse event was classified as 47 (34.1%) not serious and 91 (65.9%) serious, including 17 (12.3%) deaths. Of 353 other ivermectin adverse events, 183 (51.8%) were reported by a consumer, 165 (46.7%) by a healthcare professional, and 5 (1.4%) by other/not specified. Of the 320 cases with known patient sex, 89 (27.8%) were male and 231 (72.2%) female. Of the 226 patients with a reported age, the mean age was 50 years (range 0–98 years). No other substances were reported in 184 (52.1%) of the cases. The adverse event was classified as 230 (65.2%) not serious and 123 (34.8%) serious, including 23 (6.5%) deaths. Among the 236 COVID-19-related and other adverse events with no other reported substances, the most frequently reported reactions were 21 (8.9%) erythema, 13 (5.5%) rash, 13 (5.5%) rosacea, 11 (4.7%) pruritis, 11 (4.7%) skin burning sensation, and 9 (3.8%) skin irritation.
Conclusions: The majority of COVID-19-related ivermectin adverse events were reported by healthcare professionals, involved male patients and older patients, involved other substances, and were serious. In contrast, the majority of other ivermectin adverse events were reported by consumers, involved female patients, did not involve other substances, and were not serious.

KEYWORDS Ivermectin; COVID-19; adverse events

maximillianavila@gmail.com

128. A Poison center reevaluation of the labetalol and carvedilol out-of-hospital triage guidelines

Curtis Elko[a] and Angie Truong[b]

[a]Washington Poison Center, Seattle, WA, USA; [b]University of Washington, Seattle, WA, USA

Background: Guidelines (since 2005) for beta-blocker out-of-hospital poison center (PC) management suggest the pediatric referral threshold for labetalol (LAB) is ≤20 mg/kg and for carvedilol (CAR) is ≤0.5 mg/kg. For comparison, the initial pediatric single oral therapeutic dose for LAB is 0.5–1.5 mg/kg (hypertension) and for CAR is 0.05 mg/kg (heart failure). This PC study reevaluates the pediatric out-of-hospital thresholds for LAB and CAR.

Methods: This PC's unintentional exposures for LAB from years 2000-Feb 2022 and CAR 2019-Feb 2022 were collected when involving children ≤12 years old. Age, gender, weight, clinical effects, treatments and outcomes were exported to an Excel® file for analysis. Estimated doses were abstracted from case notes. Cases were excluded if observation times were <2 h for LAB or were <4 h for CAR. Where weight was not given, estimates were used from the CDC age/gender growth curves at the 50th percentile. Where a tablet formulation was known but number of tablets taken was uncertain, 1 tablet was assumed for symptomatic (SX) cases and 1/2 tablet was assumed for asymptomatic (ASX) cases. Partially recovered tablets were evaluated as 1/2 tablet. For LAB cases, co-ingested medications lacking cardiovascular effect were allowed. CAR cases were single substance only. When GI decontamination was employed, the dose was reduced by 25%. Doses >90 percentile in the ASX groups were excluded to reduce variance for statistical analysis. Mean doses in SX and ASX cases were evaluated for a statistical difference ± confidence interval (CI) using a 2-tailed *t*-test for independent samples of unequal variance.

Results: After making exclusions, the cohorts consisted of LAB cases ($n = 45$) (SX =9 and ASX =36) and CAR cases ($n = 45$) (SX =7 and ASX =38). Males (54) and females (36) together had a mean age of 2.6 years. Cases with the 1/2 tablet assumption (partial tablets or ASX cases, unknown amounts) were 22 for LAB and 11 for CAR; the SX cases with unknown doses estimated as 1 tablet were 3 for LAB and 1 for CAR; cases with doses reduced 25% for GI decontamination were 3 for LAB and 5 for CAR; cases, where weights were estimated, were 5 for LAB and 6 for CAR; ASX cases excluded with doses >90th percentile were 5 for LAB and 6 for CAR. The mean dose ± standard deviation (mg/kg) for LAB (SX) was 8.5 ± 5.6 mg/kg and for LAB(ASX) was 6.1 ± 2.8 mg/kg. The difference in means for LAB (SX vs. ASX) was not significant (2.4 mg/kg; [95%CI −2, +6.7]; $p = 0.245$). The mean dose ± standard deviation (mg/kg) for CAR (SX) was 1.26 ± 0.67 mg/kg and for CAR(ASX) was 0.63 ± 0.36 mg/kg. The difference in means for CAR (SX vs. ASX) was significant (0.64 mg/kg [95%CI 0.03,1.25]; $p = 0.044$). The lowest dose for LAB (SX) was 2.4 mg/kg and the lowest dose for CAR (SX) was 0.6 mg/kg. Neither of these lowest SX doses had any dose adjustments made for uncertainty or for GI decontamination. SX case clinical effects included hypotension, sedation and bradycardia, but none required any specific treatment.

Conclusions: The precise estimation of a toxic dose was limited by missing case information requiring numerous assumptions. Based on the lowest dose for SX cases (LAB 2.4 mg/kg, CAR 0.6 mg/kg), the threshold for CAR (≤0.5 mg/kg) is suitable for out-of-hospital management but the LAB threshold (≤20 mg/kg) is not. Rather, we propose LAB ≤2 mg/kg to observe out-of-hospital pediatric patients ≤12 years old with unintentional ingestions.

KEYWORDS Triage; labetalol; out-of-hospital

elko@wapc.org

129. Tea tree oil exposures reported to poison centers

Anelle Menendez[a], Brett Roth[a,b] and Mathias Forrester[c]

[a]North Texas Poison Center, Dallas, TX, USA; [b]UT Southwestern Dallas Dallas, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Tea tree oil (melaleuca oil) is a volatile essential oil containing 50–60% terpenes. Tea tree oil is used topically to treat skin conditions and in vaporizers and baths to treat respiratory tract disorders. Topical use of tea tree oil may result in irritation and allergic reactions. Tea tree oil also may cause harm if ingested. Adverse effects such as central nervous system depression, ataxia, and lethargy have been reported. The objective of this study was to characterize tea tree oil exposures reported to US poison centers.

Methods: Cases were exposures to tea tree oil (Generic code 0201026) reported to the National Poison Data System (NPDS), a database that receives data from all US poison centers, during 2000–2020. The distribution of total cases was determined for patient demographics and exposure circumstances. The distribution of cases not involving other substances was determined for management and outcome.

Results: A total of 42,812 tea tree oil exposures were identified. The annual number of cases increased from 600 in 2000 to 4597 in 2017 and then decreased to 3665 in 2020. The patient age distribution was 24,056 (56.2%) 0–5 years, 1675 (3.9%) 6–12 years, 1503 (3.5%) 13–19 years, 12,799 (29.9%) 20+ years, and 2779 (6.5%) unknown age; 25,535 (59.6%) of the patients were female, 17,131 (40.0%) male, and 146 (0.3%) unknown gender. The most common exposure routes were 36,138 (84.4%) ingestion, 6431 (15.0%) dermal, 2697 (6.3%) ocular, and 1170 (2.7%) inhalation. The exposure reason was 39,460 (92.2%) unintentional, 1650 (3.9%) intentional, 1298 (3.0) adverse reaction, 215 (0.5%) other, and 189 (0.4%) unknown. The exposure site was 41,236 (97.2%) patient's own residence, 811 (1.9%) other residence, 170 (0.4%) public area, 110 (0.3%) workplace, and 485 (1.1%) other and unknown locations. No other substances were reported in 40,360 (94.3%) of the cases. Of these 40,360 cases, 34,298 (85.0%) were managed on site, 2904 (7.2%) were already at or en route to a healthcare facility, 2592 (6.4%) were referred to a healthcare facility by the poison center, and 566 (1.4%) were managed at other or unknown locations. The medical outcome was 10,079 (25.0%) no effect, 4973 (12.3%) minor effect, 539 (1.3%) moderate effect, 31 (0.1%) major effect, 4061 (10.1%) not followed-judged non-toxic, 18,228 (45.2%) not followed-minimal clinical effects possible, 1200 (3.0%) unable to follow-potentially toxic, 1248 (3.1%) unrelated effect, and 1 (0.0%) unknown; no deaths were reported. A clinical effect was reported in 11,659 (28.9%) of the 40,360 cases not involving other substances. The most frequently reported clinical effects were ocular irritation/pain ($n = 2032$, 5.0%), vomiting ($n = 1784$, 4.4%), oral irritation ($n = 1322$, 3.3%), dermal irritation/pain ($n = 1023$, 2.5%), nausea ($n = 953$, 2.4%), cough/choke ($n = 850$, 2.1%), and drowsiness/lethargy ($n = 794$, 2.0%). The most commonly reported treatments were dilute/irrigate/wash ($n = 27,979$, 69.3%), food/snack ($n = 5003$, 12.4%), and fresh air ($n = 514$, 1.3%).

Conclusions: The majority of tea tree oil exposure patients were age 0–5 years and most patients were female. The majority exposures occurred by ingestion. Most of the exposures did not involve other substances; of these, the majority did not have a serious outcome.

KEYWORDS Tea tree oil; essential oils; cns depressants

anelle.menendez@phhs.org

130. Significance of falsely low creatinine values in diagnosing massive acetaminophen ingestion

Aaron Guinn[a], Chitbhanu Singh[a], Zoë Piggott[a] and Wesley Palatnick[b]

[a]University of Manitoba, Winnipeg, Canada; [b]Health Sciences Centre, Winnipeg, Canada

Background: Massive acetaminophen (APAP) overdose may present with early lactic acidosis and mental status changes, which may obscure the history of ingestion. consumption. These findings may result from mitochondrial dysfunction induced by high levels of N-acetyl-p-benzoquinone imine (NAPQI). NAPQI is reported to cause falsely low measurements of serum creatinine in common commercial assays based on the Trinder reaction.
Case report: A 69-year-old woman was brought to hospital after being found unresponsive by her partner. Her GCS was 3 with a blood pressure of 107/62 mmHg, heart rate 100 bpm, SpO2 98% on room air, respiratory rate 6/min, and temperature 35.5 C. Bloodwork on presentation was remarkable for a lactate of 10 mmol/L and a creatinine of 7 μmol/L (0.08 mg/dL) as measured with the Roche cobas® analyzer using the Trinder reaction. Her creatinine measured 2 weeks earlier on the same machine was 56 μmol/L (0.63 mg/dL). APAP toxicity was not recognized until her level returned several hours later at 569 μg/mL. Treatment with N-acetyl-cysteine (NAc) using a 21-h protocol at twice the normal dose was initiated 12 h after she had last been seen well. An empty bottle of 100 g total sustained-release APAP was later found in her home. She was also treated with whole bowel irrigation and hemodialysis. Creatinine levels returned to baseline by 36 h after presentation. NAc infusion was continued at two-times the normal 16-h dose for 5 days total. Her peak ALT was 4871 IU/L but she never developed further hepatic dysfunction. All of her prescription medications were accounted for and no other empty pill bottles were found. She ultimately denied any coingestants.
Discussion: A previous field safety notice published by Roche described significant negative interference between NAPQI and creatinine values measured via the Trinder reaction, a common method of creatinine measurement. Acetaminophen itself does not interfere with this assay. While NAc may also interfere with the Trinder assay, our patient's abnormally low creatinine was measured before NAc treatment was initiated. As she had no known exposure to any other substances reported to interfere with this assay, high serum levels of NAPQI were the most likely etiology. Falsely low creatinine values due to NAPQI have not been previously reported in the clinical setting. This finding suggests that NAPQI levels may be significantly elevated in peripheral blood in massive APAP overdose, supporting the plausibility of NAPQI as a causative agent in the toxicodynamics of this syndrome. Patients presenting with massive APAP n ingestion may not have a clear history of overdose. An abnormally low serum creatinine value in a patient presenting with mental status changes and lactic acidosis should prompt consideration of a significant APAP ingestion.
Conclusions: Massive acetaminophen ingestion may cause falsely low serum creatinine values, likely due to interference of NAPQI with common commercial assays. This finding may serve as an important diagnostic clue to acetaminophen ingestion in undifferentiated patients with mental status changes and lactic acidosis, potentially allowing earlier initiation of treatment.

KEYWORDS Acetaminophen; creatinine; NAPQI

aaronjguinn@gmail.com

131. Paresthesia after dermal exposure to a rough skin newt

Justin Delgado[a] and Angela Regina[b]

[a]SBH Health System, Bronx, NY, USA; [b]St. Barnabas Hospital, Bronx, NY, USA

Background: Tetrodotoxin (TTX) is one of the most toxic substances to known to humans. Although a toxic dose has not been established, a single dose of 1–2 mg of purified TTX can be lethal. TTX is most commonly recognized within the Pufferfish, but it is also present in several species including the Rough Skin newt (*Taricha granulosa*). It has been shown that even while in captivity, the Rough Skin newt maintains high levels of TTX in their skin. Symptoms of acute toxicity can range from localized paresthesia to full body numbness, dysarthria, dysphagia, headache, nausea and vomiting, abdominal pain, diarrhea, ascending paralysis to respiratory failure, leading to death. There are few case reports of toxicity after ingestion of the Rough Skin newt, but none found following dermal exposure.
Case report: A 29-year-old male presented to our urban academic center with the sensation of "tingling" in his hand after holding his pet Rough-Skin Newt. He was cleaning the enclosure and admitted to handling the newt with his bare hand for approximately ten minutes. The patient described the sensation of pins and needles, along with numbness. He had no other complaints. His vital signs were within normal limits. Physical exam revealed decreased sensation to the third and fourth digits of the left hand, with full range of motion and strength of the wrist, hand and fingers. There were no signs of trauma to the upper extremity. The regional Poison control center and the in-house toxicologist were consulted with recommendation for continuous monitoring, as this newt was known to secrete the neurotoxin tetrodotoxin. Neurological checks were performed every 2 h overnight, and there was no progression of his symptoms and no respiratory compromise. The patient was discharged from the hospital on the next day with return precautions. At his 1 week follow up with Neurology, he was noted to have full sensation and resolutions of all symptoms.
Conclusions: Tetrodotoxin is a neurotoxin found in over 100 marine species. Not many cases of human exposure from a Rough skin newt have been reported in the literature, and those published describe ingestion of the creature with severe morbidity and mortality. This case illustrates that there is potential exposure to TTX from the newt through dermal contact and that toxicity should be considered in similar dermal exposure among exotic animal enthusiasts.

KEYWORDS Tetrodotoxin; newt; dermal exposure

jdelgado1@sbhny.org

132. Iatrogenic administration of ondansetron during neonatal circumcision

Sheila Goertemoeller[a], Nicole Kaiser[b], Alysha Behrman[a] and Shan Yin[a]

[a]Cincinnati Childrens Hospital Medical Center's Drug and Poison Information Center, Cincinnati, OH, USA; [b]University Hospitals Rainbow Babies and Childrens, Cleveland, OH, USA

Background: Circumcision is the most widespread surgical procedure performed in neonates. Dorsal penile nerve block is achieved with injectable lidocaine prior to this elective

procedure. We report a first case of an iatrogenic error involving the administration of 2 mg of ondansetron, an antiemetic, instead of lidocaine.
Case report: A 2-day-old neonate was scheduled for a routine circumcision. The nurse had a tray of medications with her back turned. The obstetrician meant to use lidocaine prior to the procedure, but accidentally grabbed and injected ondansetron 2 mg from the tray and injected it intramuscularly (IM) into the pubic symphysis area. The error was discovered immediately, and the surgery was halted. About 17 min after the ondansetron dose the patient had a heart rate (HR) of 117 and respiratory rate of 44. His electrocardiogram showed a QTc of 526 milliseconds. Over the next several hours his HR fluctuated from 90 to 130, and his QTc ranged from 466 to 487. The site of the injection looked normal. Nearly 24 h post the injection his HR was 108 and his QTc was 480. He was admitted to the neonatal intensive care unit where his HR continued to fluctuate between 84 and 140 but his QTc was noted to be improving. Mild edema of the penis without erythema was noted and the neonate had normal micturition. Over the course of the next day, he continued to improve and returned to baseline. He was discharged 2 days post the iatrogenic event with a HR of 131 and QTc or 413.
Discussion: The neonate was given an IM dose of 0.7 mg/kg ondansetron. The recommended intravenous dosage for older infants is 0.1–0.3 mg/kg. While pharmacokinetic parameters with therapeutic dosing of ondansetron are well established, there are no toxicokinetic information post IM injection. The clearance of ondansetron in pediatric patients 1 month to 4 months is slower and the half-life is 2.5-fold longer than patients who are >4 months old. The patient's bradycardia and QTc prolongation persisted for 2 days post injection. The single dose ondansetron vial was used which has the hydrochloride dihydrate salt of ondansetron. It also contains sodium chloride, citric acid monohydrate and sodium citrate dihydrate as buffers. Edema at the site of the injection was reported.
Conclusions: We report a first case of bradycardia, QTc prolongation and penile edema post administration of ondansetron into the pubic symphysis area during a routine circumcision resulting in an iatrogenic event.

KEYWORDS Ondansetron; circumcision; iatrogenic
sheila.goertemoeller@cchmc.org

133. Iatrogenic error leads to systemic cyclopentolate toxicity in an infant following ocular instillation

Alysha Behrman, Sheila Goertemoeller and Shan Yin

Cincinnati Drug and Poison Information Center, Cincinnati, OH, USA

Background: Cyclopentolate is used prior to refraction examination as a cycloplegic and mydriatic agent. It has a rapid onset of 30 min and duration of up to 24 h. Systemic toxicity has been reported with as little as one drop in an adult. We report a case of cyclopentolate systemic toxicity following an iatrogenic misadventure of using the correct amount of an incorrect strength in an infant.
Discussion: A 1-month-old male infant presented to the emergency department because he had fallen off a bed. During routine examination for pupillary response 2 drops of cyclopentolate 2% was instilled into each eye accidentally instead of the 0.5% strength. Following administration, the infant became more lethargic, and the overdose was discovered. The local poison control center was contacted 45 min post discovering the error. The infant was described as having good tone with mydriatic pupils and "looked dry." He had a heart rate of 130, respiratory rate of 40 and an oxygen saturation of 95%. Since this presentation did not require reversal with a cholinergic agent, supportive care and observation was recommended with periodic follow up. Five hours post, the infant was described as anuric, with new onset tremors and had remained mydriatic. He had a heart rate of 140, blood pressure of 105/80 and a temperature of 36.8 °C. He was reportedly less fussy, and the lethargy previously reported had resolved. Fourteen hours post exposure, the infant was reportedly back to baseline neurological status although his pupils were still sluggish. He had good urine output and normal vital signs. Twenty hours post exposure, the infant was completely back to baseline and was medically cleared. Case discussion Neonatal systemic toxicity from ocular instillation of cyclopentolate has previously been described in the literature. Ophthalmic medications often contain high concentrations of active ingredient due to poor absorption into eye tissue. Infants may be more likely to experience systemic effects from ophthalmic medications due to lower body mass, blood volume and immaturity of major systems including the excretory, nervous and cardiovascular systems. Usage of the incorrect strength and subsequent toxicity in this infant necessitated an overnight observation in a healthcare facility. His systemic symptoms resolved without treatment 20 h post the iatrogenic error.
Conclusions: We describe a case of systemic cyclopentolate toxicity following an iatrogenic dosing error in an infant including lethargy, tremors, and urinary retention with full resolution 20 h post ocular instillation.

KEYWORDS Cyclopentolate; iatrogenic; ocular
alysha.behrman@cchmc.org

134. Laser pointer-related ingestions and ocular injuries treated at emergency departments

Bashir El-Khoury[a], Mark Winter[b] and Mathias Forrester[c]

[a]University of Texas Medical Branch, Galveston, TX, USA;
[b]University of Texas Medical Branch, Texas City, TX, USA;
[c]Independent Researcher, Austin, TX, USA

Background: Laser pointers/pens are handheld devices used for pointing out objects. Depending on a laser's wavelength, power, exposure time, localization, and spot size, laser pointers can cause ocular photothermal injury, a concern that has grown in recent years given the risk to the aviation community. In 2020 alone, the US Federal Aviation Administration (FAA) reported over 6800 laser incidents, an increasing trend which may pose operational risks during the critical phases of flight. Furthermore, parts of the laser pointer itself may be ingested. The objective of this study was to describe laser pointer-related ingestions and ocular injuries managed at US emergency departments (EDs).
Methods: Data for this study was obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. Laser pointer-related injuries reported during 2000–2020 were identified by reviewing all records with product code 0562 (Laser pointer) in any of the product code fields or "laser," "lasor," "lazer," or "lazor" in the Narrative text field. Injuries other than ingestion or ocular exposure ($n = 9$) were excluded from the study. The distribution of the two types of laser pointer-related injuries was determined for various factors.
Results: Of 38 total laser pointer-related ingestions identified in the sample of US EDs, 6 (15.8%) occurred during 2000–2006; 7 (18.4%) during 2007–2013; and 25 (65.8%) during 2014–2020. The part of the laser pointer that was ingested was 35 (92.1%)

battery, 1 (2.6%) cap, 1 (2.6%) metal part, and 1 (2.6%) plastic part. The patient age distribution was 29 (76.3%) 0–5 years, 7 (18.4%) 6–12 years, 0 (0.0%) 13–19 years, and 2 (5.3%) 20 years or older. Twenty-two (57.9%) of the patients were male and 16 (42.1%) female. Thirty-five (92.1%) of the patients were treated or examined and released and 3 (7.9%) treated and admitted for hospitalization. Of the 47 ocular injuries identified, 15 (31.9%) occurred during 2000–2006, 12 (25.5%) during 2007–2013, and 20 (42.6%) during 2014–2020. One patient (2.1%) was 0–5 years, 12 (25.5%) 6–12 years; 12 (25.5%) 13–19 years; and 22 (46.8%) 20 years or older. Thirty-nine (83.0%) patients were male and 8 (17.0%) female. Forty-three (91.5%) of the cases were treated or examined and released and 4 (8.5%) left without being seen/against medical advice. The most common reported injuries were ocular irritation/pain in 22 (46.8%) cases, blurred vision in 9 (19.1%) cases, unspecified ocular injury in 7 (14.9%) cases, and headache in 6 (12.8%) cases.
Conclusions: Although uncommon, laser pointer-related ingestions and ocular injuries treated at US EDs have increased in recent years. While the majority of ingestions involved children age 5 years old and younger, over half of the ocular injuries involved children age 6–19 years with both types of injury demonstrating a male predominance. Given the ubiquitous nature of laser pointers and ease of availability for both children and teenagers, the astute clinician should be aware of the increased incidence of laser pointer-related injuries related to their use and misuse and always consider them during initial evaluation.

KEYWORDS Laser; pointer; ocular

bbelkhou@utmb.edu

135. Human exposures to *Phytolacca americana* in Kentucky: characterization of toxicities, treatments, and outcomes

Jordan Woolum[a], Peter Akpunonu[b], Meredith Johnson[c] and Ashley Webb[d]

[a]University of Kentucky HealthCare, Lexington, KY, USA; [b]Department of Emergency Medicine, University of Kentucky, Lexington, KY, USA; [c]University of Kentucky College of Medicine, Lexington, KY, USA; [d]Kentucky Poison Control Center, Louisville, KY, USA

Background: *Phytolacca americana*, known more commonly as pokeweed, is a large perennial plant found ubiquitously throughout the US. Although historically used for various ailments, it is no longer medically used, with patients working outdoors now most likely to encounter it. Despite known toxicities, characterization of pokeweed exposure demographics, symptoms, treatments, and outcomes is currently limited. The objective of this study is to describe human pokeweed exposures, treatments, and outcomes, in the state of Kentucky, between 2000 and 2019.
Methods: The National Poison Database System was queried for all *Phytolacca americana* exposures in the state of Kentucky between 2000 and 2019. After the removal of non-human cases, investigators independently reviewed data to ensure all coding was appropriate as defined by the standards set forth by NPDS. During the independent review, demographic variables such as age, gender, and location of exposure were collected. Additional variables assessed include reported exposure reason, route of exposure, exposure substance, management site, and medical outcome. Clinical effects and recommended therapies were also identified. The primary objective of this study was to describe pokeweed exposure demographics within the state of Kentucky during the previously established timeframe. Secondary objectives included characterizing pokeweed treatment trends and evaluating their affiliated medical outcomes.
Results: 1669 cases of human pokeweed exposure were reported in the state of Kentucky between 2000 and 2019. Patients were predominantly young in age, with a median age of 3 years reported. The majority of patients were male (54.9%), with unintentional exposures representing most exposure reasons (97.2%). Oral ingestion of plant material represented the bulk of the exposure route (98.3%), with pokeberries most often implicated in these cases (93.9%). Exposures were generally well tolerated, with no effect being documented in 26.2% of cases, and cases not followed due to minimal expected clinical effects representing 60.5% of cases. Despite the relative tolerability, 239 total adverse events were noted during the timeframe. Abdominal pain, nausea, vomiting, and diarrhea were most common. Dermal exposures resulted in cutaneous edema, pain, and swelling. Treatments were mainly supportive, with dilution and irrigation most often recommended. One ocular exposure responded well to topical steroid and antibiotic therapy. No deaths were reported during the study timeframe.
Conclusions: *Phytolacca americana* is commonly encountered in the US. In this observational study, patients most heavily implicated in pokeweed exposures are young males. Oral ingestion was most commonly reported, with berries most often implicated. Exposures are generally well tolerated, with gastrointestinal symptoms most frequently reported. Cutaneous exposures represent an underappreciated exposure route. Treatments are largely supportive in nature.

KEYWORDS Pokeweed; toxicity; treatment

Jawool2@uky.edu

136. Amygdalin poisoning with treated with hydroxocobalamin

Garret Winkler, Justin Seltzer, Nate Friedman, Aaron Schneir and Alicia Minns

Division of Medical Toxicology, University of California San Diego, San Diego, CA, USA

Background: Amygdalin is a cyanoglycoside that has been touted as an alternate treatment for cancer. Traditionally, amygdalin is administered intravenously or subcutaneously as laetrile, and conversion to cyanide is limited. It is uncommon for amygdalin to be ingested orally with therapeutic intent, and when amygdalin is ingested cyanide is produced by beta-glucosidase. Toxicity may be delayed and recurrent due to absorption and metabolism. Toxicity and treatment are rarely reported but hydroxocobalamin would be expected to be efficacious.
Case report: This is a single-patient chart review. A 73-year-old man with metastatic squamous cell carcinoma presented to the ED with a rapid onset of confusion and dysarthria. He was afebrile, and his other vital signs were: blood pressure 153/73 mmHg, heart rate 108 beats/minute, respirations 24/minute. Initial lactic acid was elevated at 7.1 mmol/L. Within the next 2 h, he became persistently hypotensive and further history revealed that he ingested 6000 mg of an amygdalin containing product 2 h prior to presentation. He had been ingesting this product for the previous 2–3 weeks at a purported reported dose of 1000–1500 mg daily. All doses were ingested with therapeutic intent. Serial blood cyanide concentrations (mcg/mL) in relation to time of ingestion were as follows: 4.5 (5 h), 2.1 (7.5 h), 0.8 (9 h), and 0.25 (14.5 h). A normal reference cyanide concentration is up to 0.05 mcg/mL. The patient was administered 5 g hydroxocobalamin IV 6 h following ingestion. Treatment resolved his neurological abnormalities, hypotension, and lactic acidosis. He received an additional 5 g dose of hydroxocobalamin 14.5 h after ingestion for a rising lactic acid to 3.0 mmol/L. The patient then

recovered uneventfully. He left against medical advice on hospital day two, and was lost to follow-up. No product was available for testing.
Discussion: Amygdalin is a popular alternative cancer therapy that can cause cyanide toxicity when ingested. There is limited published experience treating amygdalin-associated cyanide toxicity. Hydroxocobalamin is expected to treat amygdalin-associated cyanide toxicity like other cyanide poisonings, by binding free cyanide to form cyanocobalamin. The quantity of amygdalin ingested, as evidenced by his cyanide concentration of 4.5 mcg/mL, was potentially life-threatening ingestion and was successfully treated with hydroxocobalamin. Death has been associated with cyanide concentrations greater than 3.0 mcg/mL. Clinical recognition of cyanide toxicity was delayed by approximately 4 h due to late disclosure of the culprit ingestion; hydroxocobalamin was then initiated promptly based on clinical history, physical examination, and lactic acidosis. Cyanide levels were not immediately available.
Conclusions: Hydroxocobalamin appeared efficacious in treating cyanide toxicity from amygdalin ingestion. Recognition of cyanide toxicity may be delayed in patients who are hesitant to disclose alternative therapies.

KEYWORDS Cyanide; amygdalin; hydroxocobalamin

gwink3@gmail.com

137. Severe hydrocarbon pneumonitis requiring extracorporeal membrane oxygenation in a pediatric case of makeup brush cleaner ingestion

Nate Friedman[a], Christina Rufener[b], Jordan Vaught[b], Helen Harvey[b], Nicole Coufal[b] and Christian Tomaszewski[a]

[a]University of California – San Diego, San Diego, CA, USA; [b]Rady Children's Hospital, San Diego, CA, USA

Background: Hydrocarbons are a ubiquitous component in many household solvents and cleaners. Ingestion of hydrocarbons can lead to various organ toxicities and produce a spectrum of symptoms including central nervous system depression, gastrointestinal distress, myocardial sensitization and arrhythmias, and pneumonitis. These latter two complications can be devastating. Accidental inhalation or ingestion of hydrocarbons typically follows a mild course commensurate with a small exposure. Here, we describe a case of accidental ingestion of a small volume of makeup brush cleaner remover leading to severe pneumonitis, ARDS, and multi-organ failure requiring extracorporeal membrane oxygenation (ECMO).
Case report: A previously healthy 14-month-old female presented with her parents to a referral pediatric emergency department with somnolence and cough. The patient was seen holding a bottle of the mother's makeup brush cleaner and had some liquid on her face, suggesting an exploratory ingestion. The cleaner was labeled as containing ">30 aliphatic hydrocarbons" and listed as a primary ingredient 2,2,4,4,6,8,8-heptamethylnonane. The father induced vomiting via digital stimulation. Following emesis, the patient began coughing, developed lethargy and somnolence, and exhibited intermittent apnea. In the emergency department, the patient was intubated for airway protection and admitted to the pediatric intensive care unit. In the ICU, the patient was difficult to ventilate and oxygenate. Her oxygenation index worsened from 27 to 56 despite aggressive ventilatory settings and inhaled nitric oxide. She developed hypotension requiring multiple vasopressors, bilateral pulmonary opacities on chest radiography, pleural effusions, and ascites. The next day she developed abdominal compartment syndrome necessitating placement of a peritoneal drain. Due to refractory hypotension and ongoing hypoxia, she was placed on venoarterial ECMO. She then received a single dose of intratracheal surfactant with rapid improvement in ECMO support needs. The remainder of her hospital course was complicated by spontaneous pneumothorax requiring tube thoracostomy. A computerized tomography scan of the chest revealed extensive lung necrosis. The patient continued to improve after surfactant administration and was decannulated after 72 h on ECMO. She was successfully extubated on hospital day 15 and discharged home with no respiratory support on day 35.
Discussion: Hydrocarbons form a diverse class of compounds that include aliphatic and aromatic structures. They are easily absorbed across gut mucosa and, if systemically absorbed, can produce CNS depression similar to general anesthetics. Vomiting is common and frequently results in aspiration producing a pneumonitis that can cause severe ARDS. Hydrocarbons destroy surfactant and can induce a destructive inflammatory response leading to lung necrosis. Management is largely supportive. Surfactant has been investigated in case series and animal models with equivocal results; in this case, administration of surfactant resulted in rapidly improved oxygenation.
Conclusions: Hydrocarbon ingestion is a potentially life-threatening exposure, especially in pediatric populations. Surfactant is an unproven, exploratory treatment that may have a role in severely ill patients with poor oxygenation.

KEYWORDS Hydrocarbon ingestion; makeup brush cleaner; pneumonitis

nafriedm@gmail.com

138. IV acetaminophen overdose: a review of published cases to guide risk assessment

Maryann Hofman and Kevin Osterhoudt

The Poison Control Center at Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background: An IV form of acetaminophen (APAP) was introduced in Europe in 2004 and approved by the US FDA in 2010. It is indicated for fever reduction and analgesia, and is used when oral or rectal routes may be inappropriate such as with operative and post-operative patients. Therapeutic errors have resulted in overdose and risk stratification of these events is unclear. Involved patients may be glutathione deficient, IV dosing reaches peak serum concentrations immediately and bypasses hepatic "first-pass" metabolism, and the Rumack-Matthew nomogram may or may not be applicable. The IBM Micromedex POISINDEX® database (accessed April 14, 2022) has clinical guidance that differs from TOXBASE®.
Methods: To update previous topic reviews, Ovid MEDLINE® was searched (January 28, 2022) with [acetaminophen] as subject heading, limited by keywords [toxicity OR poisoning OR overdose] and by [human]. This data set was limited by [AND "intravenous"] with retrieved articles hand searched for relevance. Citations from articles were examined and cross-indexed.
Results: 249 articles were reviewed by two investigators leading to retrieval of 10 relevant case reports and 2 aggregate reports. Eight individual case reports involved children ages newborn to 3 years; 4/8 received a single acute IV APAP overdose ranging from 75 to 150 mg/kg. A three-year-old developed a peak ALT of 1378 IU/L after a single 150 mg/kg dose; the other 3 children were treated with NAC and had no apparent hepatotoxicity. In repeat dosing, a 5-month-old with shock who had surgical resection for intussusception received 90 mg/kg of IV APAP over 6-h post-operatively, was found to have a serum APAP concentration

of 38 "mg/mL" 6 h after overdose, was not treated with n-acetylcysteine (NAC) immediately, and developed hepatic injury with a peak serum AST of 4294 IU/L at 48 h. Another 3-month-old infant was given 150 mg/kg of IV APAP twice, 12 h apart; the serum APAP was 105 mcg/mL 16 h after the second dose, IV NAC was administered, and a peak ALT of 1946 IU/L was noted at 54 h. A 16-month-old received 208 mg/kg over 30 h and developed a peak AST of 14,000 IU/L. Two adult patients have been reported with acute liver injury after 1000 mg of IV acetaminophen being given every 6 h for 13 and 16 doses. Additionally, in 2010, U.K. drug regulatory agencies reported analysis of 23 cases of intravenous APAP overdose among children aged <1 year, with one death involving an infant receiving a 10-fold overdose; and analysis of another 206 cases of which 44 occurred in neonates (2 classified as "severe").
Conclusions: IV APAP overdoses occur but are uncommon, and involved patients are likely to have risk factors for glutathione deficiency. Causality of liver injury can be difficult from case reports. One child has been identified with liver injury after as low as a 90 mg/kg dose of IV APAP, but the contribution of the shock state to the liver injury is unclear and the authors appear to have confusingly misrepresented the units of the serum APAP concentration. TOXBASE® recommends NAC treatment of any single IV APAP dose >60 mg/kg, but risk stratification after IV APAP overdose remains vexing, especially after repetitive dosing. POISINDEX® recommendations are less conservative, but case reports suggest toxicity at lower doses than after oral overdose. Uniform guidelines would be welcomed. System improvements to prevent IV APAP overdose remain paramount.

KEYWORDS Acetaminophen; therapeutic error; hepatotoxicity

hofman@chop.edu

139. Public health implications of pediatric rattlesnake envenomations: a 22-year demographic review

Laura Morehouse, Steven Dudley, Farshad Mazda Shirazi and Geoffrey Smelski

Arizona Poison and Drug Information Center, Tucson, AZ, USA

Background: Rattlesnake envenomations, while still rare, are an important public health issue in the US. Children may be at particular risk for snakebites due to outdoor play, exploratory behavior, and lack of knowledge and awareness of venomous snakes. Prior literature suggests that children are also at a higher risk for severe envenomation from a rattlesnake bite. However, limited pediatric demographic data exist to help inform public health messaging toward parents and caregivers. To optimize health education approaches in preventing envenomation, a retrospective review was performed of all available historical rattlesnake bite cases at a Regional Poison Center in the pediatric population.
Methods: Pediatric cases between January 1, 1999 and December 31, 2020 were analyzed for exposure to a rattlesnake receiving antivenom. Pediatric patients were defined as 12 years of age or lower. A total of 200 cases were identified; of those cases, 99 occurred in patients 0–5 years of age and 101 occurred in patients age 6–12 years. Demographic data collected include: age, gender, date and time of bite (morning, afternoon, evening, and night), anatomic site, and circumstance of bite. Clinical data collected includes presence or absence of coagulopathy and re-treatment after hospital discharge.
Results: Pediatric cases were split evenly between children ages 0–5 years (49.5%) and 6–12 years (50.5%). The majority of pediatric patients were male (62.5%) and bitten in the evening (44.5%). The peak months for pediatric bites were August (22%) and May (15%). A total of 70.5% of bites were located on a lower extremity, with female children more likely to be bitten on a lower extremity than male children (81.1% vs 68.1% respectively). Of lower extremity bites, 52% were children age 0–5 years; of upper extremity bites, 52% were children age 6–12. Bites in children were most likely to happen outside the house, in the yard or driveway (35%). There were 10 cases where the child was reported to have intentionally interacted with the snake. Of known intentional interaction pediatric cases, 70% were male and age 6–12. Approximately 63.5% of pediatric patients developed coagulopathy during their clinical course. Over half (52.8%) of pediatric patients with coagulopathy developed a late coagulopathy, defined by lab values obtained after hospital discharge. About 10.7% of pediatric patients returned to the hospital for additional clinical assessment after discharge; of those, 59.4% were re-treated with antivenom.
Conclusions: The peak month of envenomation for children has been August, followed closely by May. The peak time of day for envenomations is in the evening. Male children age 6–12 were the majority of bite cases and were more likely to be bitten on an upper extremity. Outdoor activities, such as playing in the yard or walking outside the home, were highly associated with bites. Children had a high occurrence of coagulopathy, with many coagulopathic values obtained post hospital discharge. Most children that returned to the hospital for additional assessment were re-treated with antivenom. Health education directed towards parents and caregivers should focus on three safety messages: (1) outdoor supervision, especially during evening hours, (2) rattlesnake identification and avoidance, and (3) the risk of a significant clinical course for children after hospital discharge.

KEYWORDS Envenomation; health education; pediatric

morehouse@pharmacy.arizona.edu

140. Poison hemlock exposures reported to US poison centers 2010–2020

Victoria Wadman[a], Karen Smith[b], Elizabeth Lyden[a] and Ronald Kirschner[a]

[a]University of Nebraska Medical Center, Omaha, NE, USA; [b]Nebraska Regional Poison Center, Omaha, NE, USA

Background: *Conium maculatum* (CM), commonly known as poison hemlock, contains coniine, a nicotinic acetylcholine receptor agonist that can cause paradoxical muscle weakness and respiratory compromise. It is considered an invasive species by some botanists. Human exposures reported to our poison center increased 100% from 2010 to 2020. The purpose of this study was to determine if CM exposures are increasing nationwide, whether there is regional variation, and if the severity of medical outcomes is changing over time.
Methods: The American Association of Poison Control Centers' (AAPCC) National Poison Data System was queried for human CM exposure cases (generic code 3011569) from January 1, 2010 through December 31, 2020. Data evaluated included exposure route, age, gender, reason, clinical effects, treatments, and medical outcome. Coingestants were not excluded. In cases with medical outcome of moderate or major effect or death, deidentified case narratives were requested from regional poison centers for further review. Fatality reports were also requested from AAPCC. Because we only worked with deidentified data, our university's institutional review board deemed the study exempt from review.
Results: There were 1859 CM exposures reported during the study period. Both the number and incidence as a proportion of

total human exposures increased from 2010 to 2020 (80 of 2,384,825 to 289 of 2,128,198). When examined by region over the 11-year period, exposures were more common In the West followed by the Midwest, South, and Northeast, but these differences were not statistically significant. Most were not followed as minimal effects were expected or were judged as nontoxic (823), had no effect (495), or minor effects (231). Unrelated effects were noted in 149; 100 were unable to be followed and judged as potentially toxic. Medical outcome of moderate effect was reported in 52, major effect in seven, and death in two cases. Among 787 cases followed to a known outcome, 61 had moderate/major effects or death. Narratives were requested for these 61 and 49 (80%), including both fatalities and six of the seven with major effects, were obtained. One fatality was a self-harm attempt that involved coingestion of multiple pharmaceuticals. The other involved an adult who ingested CM mistaken for an edible plant. Both occurred in the West. Among six patients with major effects for whom narratives were reviewed, four mistook CM for an edible plant and two intended self-harm. Three of these were from the West and three were from the South. Among 49 narratives with moderate/major/fatal effects reviewed, 24 individuals (49%) misidentified CM as a food item.

Conclusions: Reports of *Conium maculatum* exposures to poison centers are increasing; this could be due to increasing occurrence of exposures or enhanced awareness by the public and healthcare providers. We found regional differences in exposure distribution that were not statistically significant. The number of patients with medical outcomes of major effect or fatality was too small to determine a trend over the period studied. Ingestion is often due to misidentification as an edible plant.

KEYWORDS Poison hemlock; nicotinic plants; poison centers

victoria.wadman@unmc.edu

141. Large dose intentional ciprofloxacin ingestion associated with false-positive urine immunoassay for oxycodone and fentanyl

Jessica Kelly[a], Thuan Le[b], Khushbu Patel[c], Jill Posner[a] and Kevin Osterhoudt[d]

[a]Division of Emergency Medicine, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [b]Toxicology Laboratory, Hospital of the University of Pennsylvania, Philadelphia, PA, USA; [c]Chemistry Laboratory, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [d]Section of Clinical Toxicology, Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background: In the midst of both an adolescent mental health crisis, and an ongoing opioid epidemic, urine drug screening is a common test performed in hospitals; testing is also common in other settings such as in the criminal justice system or in qualification testing for life insurance, employment or athletics. Many tasked with interpreting urine drug screen results, including healthcare providers, may be unaware of limitations of these tests. False positive urine drug tests may have untoward consequences. We report ciprofloxacin as a potential cause of false-positive opioid testing on urine immunoassay-based drug screening.

Case report: A previously healthy 14-year-old girl reported estimated ingestion of 25 tablets of 500 mg ciprofloxacin (12.5 g, 154 mg/kg) from her home in a suicide attempt. She denied substance use, including opioids, and was prescribed no medications. Her family denied the presence of opioid drugs within the home. She developed gastrointestinal upset, but exhibited no other signs of a toxic syndrome. A urine drug immunoassay, obtained 10 h post-ingestion, was qualitatively positive for oxycodone (threshold concentration 100 ng/mL) and fentanyl (threshold concentration 1 ng/mL). Analysis was performed using the Ortho Clinical Diagnostics VITROS® 4600 Chemistry System with the DRI Oxycodone (ThermoFisher) and ARK Fentanyl II (ARK Diagnostics) reagents. Serum tests for acetaminophen, salicylate and ethanol were negative; advanced toxicology testing found no drugs other than ciprofloxacin. Specific confirmatory analysis for opioids was performed with liquid chromatography tandem mass spectrometry (LC/MSMS) and did not detect any oxycodone, fentanyl (or metabolites), or other opioids.

Discussion: Acute opioid poisoning may be managed based upon clinical findings. Still, proper identification of un-prescribed opioid use may be important as it can reveal opioid use disorder, and it may inform risk for impending opioid withdrawal syndrome. In the hospital, false-positive opioid testing may lead to misdiagnosis, inappropriate treatment, damaged therapeutic alliance, and stigma. In other settings, false positive testing may lead to erroneous decisions of ineligibility for employment or other programs, or may incur criminal justice penalties. In this case, it was concluded that the urine immunoassay drug screen was falsely positive for oxycodone and fentanyl due to cross-reactivity with ciprofloxacin; neither the emergency department clinicians nor the mental health services team were aware of the phenomenon. Quinolones have been implicated to interfere with opioid tests, but ciprofloxacin was not listed as a potential interference in the fentanyl reagent manufacturer's package insert.

Conclusions: Many healthcare providers have limited knowledge of drug immunoassay cross-reactivity. Ciprofloxacin is commonly prescribed among adolescents and young adults who may present for care of intentional drug ingestion/overdose. Due to evolution of the opioid epidemic, routine testing for semi-synthetic and synthetic opioids is relatively new. We alert healthcare providers to the principle of false-positive opioid drug screening due to fluoroquinolone antibiotics, and remind of the potential importance of confirmatory testing after initial screening. In this case, a large dose of ciprofloxacin was ingested; the cross-reactivity of ciprofloxacin at therapeutic dosing levels, or with other analyzer systems, is unknown.

KEYWORDS Ciprofloxacin; urine drug screen; fentanyl

kellyj12@chop.edu

142. Talking numbers, comparison of recreational drug presentations to the emergency room in Europe and Northern Africa

Klara De Baerdemaeker[a], EMCDDA EU4MD/IPA7 Research Group[b], Ilze Jekabsone[c], Thomas Néfau[c], Katerina Skarupova[c], Isabelle Giraudon[c], John Archer[a], Alison Dines[a], David Wood[a] and Paul I. Dargan[d]

[a]Guy's and St Thomas' NHS Foundation Trust, London, England; [b]EU4MD/IPA7 Research Group, EMCDDA, Lisbon, Portugal; [c]European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), Lisbon, Portugal; [d]Toxicology Office, London, England

Background: The European Drug Emergencies Network (Euro-DEN) was developed to facilitate data-collection and monitoring of acute toxicity related to the use of recreational drugs and novel psychoactive substances (NPS) across Europe. The aim of this pilot study was to investigate the feasibility of data collection using the Euro-DEN Plus methodology from sentinel emergency departments in countries neighbouring the European Union (EU) in Eastern Europe, Middle East and North Africa. The study was implemented in the framework of the EU4Monitroing Drug and EMCDDA-IPA7

projects, both funded by the European Union. The collected data were compared with the main Euro-DEN Plus dataset.
Methods: Seven centres participated in this pilot project: Bab El Oud and Oran in Algeria, Tunis in Tunisia, Beirut in Lebanon, Haifa in Israel, Belgrade in Serbia and Tirana in Albania. Data were collected retrospectively using Euro-DEN methodology from routine medical records during at least 6 months of 2021 on all presentations with acute recreational drug toxicity and presentations related to acute toxicity from prescription medicine misuse. In the lead centre in London, UK, data were cleaned and analysed in comparison to the Euro-DEN dataset (23,947 presentations to 31 centres in 21 European countries from 2014 to 2017). Each centre had appropriate local ethical approval for collecting and sharing data.
Results: There were 741 presentations to the seven participating centres; there was a similar sex and age distribution between this pilot dataset and the Euro-DEN dataset [Males: Pilot study 80.4% versus Euro-DEN 76.2%; Median (IQR) age: Pilot study 30 years (23–37years) versus Euro-DEN 31 years (25–39 years)]. Similar to the Euro-DEN dataset, illicit drugs were most common, although a lower proportion of presentations involved illicit drugs (59.5% versus 66.9%). There was a greater proportion of prescription medicines in the pilot dataset (36.1% versus 23.0%) and no presentations involving NPS, compared to 9.0% in the Euro-DEN dataset. The top 3 drugs involved in the presentations in the 7 pilot centres were cannabis, cocaine and heroin respectively, these were the same in the Euro-DEN dataset albeit in a different order. Pregabalin, methadone and clonazepam were the three most reported prescription medicines in the pilot centres compared to clonazepam, unknown benzodiazepines and methadone. The median length of stay from presentation to the emergency department to discharge from the hospital was exactly 5 h (IQR 02:00 h to 23:00 h) for all centres. Comparable to the Euro-DEN dataset, 69% were directly discharged from the emergency department. Admissions to critical care were lower at 6.9% (versus 24.8%), but more patients went to psychiatric wards 11.6% (versus 4.5%); one patient died in the emergency department.
Conclusions: We analysed data on acute drug toxicity presentations to seven emergency departments in Eastern Europe, Northern Africa and Middle East. Patient demographics were similar to the main Euro-Den dataset, and illicit drugs were most commonly involved in the presentations. In contrast to the Euro-DEN dataset, there were more presentations involving prescription medicine misuse but no presentations involving the use of NPS. There is a paucity of data on the prevalence and harms associated with drug use in these countries and these data therefore provide an important insight into the public health implications of drug use in these c

KEYWORDS Monitoring; recreational use and toxicity; emergency room presentations

klarade.baerdemaeker@gstt.nhs.uk

143. Increased availability to at-home COVID-19 test kits results in increased calls to the poison center

Michelle Dougherty[a], Margaret Maher[a], Jeanna M Marraffa[b], Christine Stork[b] and Vincent Calleo[a]

[a]Upstate NY Poison Center, Syracuse, NY, USA; [b]SUNY Upstate Medical University, Syracuse, NY, USA

Background: At-home COVID-19 test kits are readily available. The federal government increased access by mailing free test kits and also reimbursing test kit purchases through private insurance companies. In late 2021, poison centers identified an increased number of calls related to unintentional exposures due to the incorrect use of these test kits.We sought to evaluate the total number of calls and toxicity related to COVID-19 home test kits at one poison center.
Methods: We performed an IRB-exempt, retrospective review of calls to a single poison center from September 1, 2021 through March 31, 2022. Extracted cases included human exposure calls for COVID-19 test kits using the generic code 0077801. Cases were excluded if they had this generic code but did not involve COVID-19 test kit exposures. Data collected included: age, gender, clinical effects, outcome and management site.
Results: Forty nine distinct cases were identified. All cases were managed at home and did not require healthcare evaluation. Gender breakdown revealed 30 females, 17 males, and 2 cases where no gender was documented. There were 28 adults and 21 children. 24 cases involved the inadvertent ingestion of the liquid reagent, 10 cases were from ocular exposure, 3 cases were dermal exposures and 12 cases occurred from inadvertent placement of the reagent in the nares. Pain and irritation were the most commonly documented clinical effects and documented in 8 cases. Two cases reported red eye/conjunctivitis. No commercial kit consistently resulted in calls to the poison center. Product breakdown revealed 14 Binax Now®, 4 Carestart®, 6 iHealth®, 2 Access Bio®, 2 InteliSwab®, and the remainder not documented.
Discussion: Unintentional exposure to at-home COVID test kits appears to result in oral, ocular and nasal exposures. Fortunately, our dataset found limited toxicity despite these kits containing a number of hazardous compounds in their reagents. The typical volume of reagent in home test kits is small (<1 mL) which limits potential toxicity. Our data supports this as none of our cases reported systemic toxicity. Our study has several limitations including the retrospective nature of the analysis and the challenges inherent with poison center data. It is impossible to know if any cases subsequently developed systemic toxicity after the initial poison center call. Additionally, all of our cases were from unintentional exposures and therefore it is impossible to extrapolate the relatively low risk of toxicity if larger quantities were ingested or if someone intentionally ingested the liquid reagents.
Conclusions: Inappropriate use of at-home COVID-19 test kits caused an increased number of calls to poison centers; however, their toxicity appears to be mild and consists mainly of local irritation. Systemic toxicity appears to be quite low risk given our data. Pain and irritation were the most commonly reported symptoms and all cases were able to be managed at home. Given the increased access to these products and the ongoing pandemic, poison centers should focus public education efforts on the safe use of these at-home test kits.

KEYWORDS COVID-19; reagent; poison center

chelle1464@verizon.net

144. Mushroom ingestions by dogs reported to poison centers

Jeanie E. Shawhart[a] and Mathias Forrester[b]

[a]Texas Tech University Health Sciences Center Jerry H. Hodge School of Pharmacy, Amarillo, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: As with humans, certain mushrooms are dangerous if ingested by dogs. Depending on the type of mushroom, symptoms of poisonous mushroom ingestion by dogs include vomiting, diarrhea, seizures, tremors, hallucinations, and excessive drooling and urination. The objective of this study was to describe mushroom ingestions by dogs reported to poison centers that primarily manage human exposures.
Methods: Cases were mushroom exposures (Generic codes 0032000, 0032001, 0036687, 0053000, 0054000, 0055000, 0056000, 0057000, 0058000, 0059000, 0264000) reported to a large, statewide poison center network during 2000–2020 where

the exposure route was ingestion, the patient species was animal, and the animal type was dog. The distribution of cases was determined for various factors.
Results: A total of 366 mushroom ingestions by dogs were identified. There were 30 (8.2%) ingestions during December-February, 77 (21.0%) during March–May, 129 (35.2%) during June-August, and 130 (35.5%) during September-November. The ingestion occurred at the home of the dog's owner or caregiver in 278 (76.0%) cases, 3 (0.8%) at another residence, 3 (0.8%) public area, and 82 (22.4%) at an unknown location. The management site was 209 (57.1%) on site (outside of a healthcare facility), 145 (39.6%) at a healthcare facility or other location (probably a veterinarian facility), and 12 (3.3%) at an unknown location. The most commonly reported clinical effects were vomiting ($n = 71$, 19.4%), drowsiness/lethargy ($n = 14$, 3.8%), diarrhea ($n = 11$, 3.0%), nausea ($n = 8$, 2.2%), and seizure ($n = 5$, 1.4%). The ingestion was not serious (no effect, minor effect, moderate effect, not followed-judged nontoxic, not followed-minimal effects possible) in 222 (60.7%) cases, serious (moderate effect, major effect, unable to follow-potentially toxic, death) in 143 (38.8%), and unrelated to the ingestion in 1 (0.3%); 1 (0.3%) death was reported, but the poison center network generally does not follow animal exposures to determine final outcome.
Conclusions: Mushroom ingestions by dogs most often occurred in the summer and autumn and at the owner's home. Although a greater proportion of cases did not result in serious outcomes, a significant number did have serious effects.

KEYWORDS Dog; mushroom; poison center
jeanie.jaramillo@ttuhsc.edu

145. Nationwide aquatic envenomations reported to US poison control centers from 2011 to 2020

Tyler Kirchberg[a], Lee Cantrell[b], Christanne Coffey[c] and Christian Tomaszewski[c]

[a]UC San Diego School of Medicine, La Jolla, CA, USA; [b]CPCS – San Diego, San Diego, CA, USA; [c]University of California – San Diego, San Diego, CA, USA

Background: Aquatic envenomations are common injuries seen along the coastal US. While rarely fatal, they are a significant public health risk in these regions and can cause significant morbidity. Increases in population and coastal development coupled with rising ocean temperatures and sea level are likely to result in more human interaction with marine animals. There are no recent reports published dedicated to the epidemiology of aquatic envenomations in the US The goal of this project is to examine aquatic envenomations, both venomous bites and stings, that were called in as exposures to poison control centers (PCC) in the US from 2011 to 2020.
Methods: A retrospective review of all aquatic envenomation injuries in the US reported to the American Association of Poison Control Center's (AAPCC) National Poison Data System was performed. Data were obtained and analyzed for all aquatic envenomation cases reported for the 10-year period from January 1, 2011 to December 31, 2020. Specific data extracted included date and time of the report, exposure and reporter site, patient age and gender, route of exposure, signs and symptoms, management site, treatments, and clinical outcome. Clinical outcomes of exposure are further broken down into categories: no effect, minor effect, moderate effect, major effect, or death. Duplicated records, cases with confirmed non-exposure, and reports not originating within the US were excluded.
Results: From 2011 to 2020, 8759 human aquatic envenomations were reported to the AAPCC Toxic Exposure Surveillance System database. Of these exposures, 5407 (61.7%) were male. By age if reported, 14.5% were younger than 11 years, 20.3% were 11–20 years, 21.2% were 21–30 years, and 43.8% were older than 30 years. There was a mean average of 875 calls per year, with 45.5% of calls each year occurring during the three summer months from June to August. California, Texas, and Florida had the highest total number of envenomations during the study period; however when examining rate of envenomation per 100,000, incidence was highest in Wyoming (29.6), Vermont (26.7), and North Dakota (24.8). During the study period, 2583 (29.5%) of these cases referred to AAPCC were treated in health care facilities, an annual average of 258 cases per year. There were no deaths reported and only 21 major adverse outcomes noted during this 10-year period.
Conclusions: The highest proportion of aquatic envenomation injuries occurred during the summer months from June to August, with most patients being male and under 30 years old. During the study period, there was a slight decline in envenomation injuries reported to PCC. While rarely leading to major adverse events or death, aquatic envenomations are commonly reported injuries to PCC in all 50 states. Poison control centers continue to be reliable sources of information and data regarding aquatic envenomation trends.

KEYWORDS Aquatic; envenomation; poison control
tkirchbe@health.ucsd.edu

146. The decriminalization of illicit drug possession and its effects on heroin body stuffers in Oregon

Ruby Hoang and Robert Hendrickson

Oregon Health and Science University, Portland, OR, USA

Background: On February 1, 2021, Oregon enacted ballot measure 110 to decriminalize the personal possession of controlled substances. The penalty for heroin possession was reduced from a misdemeanor to violation and felony to misdemeanor for possession of <1 g and 1–3 g, respectively. Many heroin users resort to "body stuffing," internal concealment of illicit drugs, to evade police detection or prosecution of possession. Ultimately, this dilemma places the "body stuffer" at risk of developing opioid toxicity leading to health care utilization and cost. The objective of this study is to describe the characteristics and determine the effect of measure 110 on heroin body stuffers in Oregon.
Methods: This is a retrospective chart review of heroin body stuffers reported to a single poison center for the one-year before and one-year after the implementation of the measure (February 1, 2020–January 31, 2022). Inclusion criteria were cases with "heroin" in the "substance" data field. Exclusion criteria were non-human exposures, information cases, if the case did not describe the internal concealment of heroin for the purpose of avoiding drug possession prosecution, cases from outside of Oregon, and cases where the history of body stuffing was later retracted. All cases were reviewed by a single reviewer and the following data collected: age, sex, reported ingestion amount, disposition, and packaging type. Data is reported as a percentage of known values and the proportion of subjects in groups of dichotomous outcomes were compared using the Chi-square test.
Results: 384 cases were reviewed and 204 met inclusion/exclusion criteria. There was no change in the number of cases in the one-year period before and the one-year period after the measure passing (102 v 102). The majority of patients ingested heroin orally (200/204; 98%) vs rectal concealment (4/204; 2%). In the post-implementation period, patients were more likely to ingest ≥ 3 g of heroin (45.9% v 28.4%, $p = 0.02$), be discharged from the

emergency department (51.0% v 33.7%, $p = 0.01$), and less likely to sign out against medical advice (15.7% v 35.6%, $p < 0.01$).
Discussion: There was no difference in the number of heroin body stuffers reported to a single poison center before and after passing a law that decriminalized heroin possession. Additionally, patients in the post implementation period were more likely to conceal $\geq$3 g of heroin and more likely to be seen and treated in the ED without admission. We hypothesize that the effect of the measure allowed patients to more freely communicate the exposure amount with their health care providers. Limitations of the study include its retrospective nature, passive data collection of poison center record, and incomplete data.
Conclusions: We found no difference in the number of heroin body stuffer cases in Oregon after the implementation of measure 110 to decriminalize personal drug possession.

KEYWORDS Heroin; body stuffer; Oregon

hoangr@ohsu.edu

147. Propofol and QT prolongation: coincidence or causation?

Rejs Ademovic[a], Margaret Maher[b], Jeanna Marraffa[a,b] and Ross Sullivan[a]

[a]SUNY Upstate Medical University, Syracuse, NY, USA; [b]Upstate NY Poison Center, Syracuse, NY, USA

Background: Propofol is commonly used for sedation in critically ill patients. Critically ill patients are at greater risk for QT prolongation due to several factors including electrolyte abnormalities and receiving QT prolonging drugs. Historically, propofol has not been linked to QT prolongation and electrocardiogram (ECG) monitoring is not routinely recommended. However, there are some case reports and at least one retrospective cohort study linking QT prolongation with propofol in acutely ill patients. We report a case of significant QT prolongation associated with the administration of propofol and confirmed with re-challenge.
Case report: A 54-year-old female was found unresponsive after a reported overdose of 60 tablets of levetiracetam 750 mg and 25 tablets of amitriptyline 100 mg. Gabapentin and sumatriptan were also available though not believed to be part of the ingestion. The patient was intubated upon arrival at the Emergency Department (ED) due to CNS depression. Initial vital signs include BP 151/111 mmHg; Heart rate 93 bpm; Temperature 96.6 F. Initial ECG revealed sinus rhythm with QRS 98 ms and QTc 474 ms. Propofol was initiated for sedation. Approximately 4 h after ED arrival, the QTc prolonged to 695 ms (QRS remained narrow 96 ms). Intravenous magnesium was given and electrolytes were optimized. Propofol was considered a possible culprit and sedation was changed to a midazolam infusion. Two hours after the propofol was discontinued, the QTc was 469 ms. Propofol was restarted approximately 4 h later and the QTc prolonged to 728 ms. The following morning, the propofol was once again discontinued and the QTc went from 695 ms to 469 ms. The patient was extubated the following day and ECG showed a QTc 446 ms.
Discussion: We present a case of QT prolongation receiving sedation with propofol following intentional overdose of levetiracetam and amitriptyline. Naranjo causality assessment scale yielded a score of 6, indicating a probable association. This case has several confounding factors including the presence of amitriptyline and the possibility of other co-ingestants. Though rare, there is some literature that propofol may prolong the QTc. One observational cohort study of 96 patients receiving a propofol infusion for more than 3 h had a mean QTc prolongation of 30.4 ± 55.5 ms. Sakabe et al reports a woman that had prolongation of QTc from 440 ms to 690 ms 4 h after initiation of propofol. Irie et al describe a case of Torsades de Pointes after a marked elevation of his QTc to 720 ms from a baseline of 390 ms after 15 h of propofol infusion. Several mechanisms have been theorized that support QT prolongation as an adverse effect of propofol. In a recent study, propofol was shown to inhibit multiple repolarization potassium channels including ITo and IKur, prolonging the cardiac action potential. A previous in vitro study of guinea pig ventricle cells found a deactivation in outward potassium channels suggesting possible QT prolongation. The clinical significance remains unknown.
Conclusions: Though rare, propofol may be associated with QT prolongation. In critically ill patients, propofol should be considered a potential factor in contributing to QTc prolongation and alternative sedation should be considered if a patient has persistent, unexplained QT prolongation.

KEYWORDS Propofol; QTc prolongation; cardiac toxicity

ademovir@upstate.edu

148. Pediatric lighter fluid exposures treated at emergency departments

Brett Roth[a,b], Thi Nguyen[a,b], Enrique Robles[a,b] and Mathias Forrester[c]

[a]UT Southwestern Dallas, Dallas, TX, USA; [b]North Texas Poison Center, Dallas, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Lighter fluid is a flammable liquid hydrocarbon found in cigarette lighters and other types of lighters. Some of the hydrocarbons included in lighter fluids are benzene, butane, hexamine, lacolene, naptha, and propane. Exposure to lighter fluid may occur through ingestion, inhalation, aspiration, dermal, or ocular routes. Lighter fluid exposures may result in oral or throat irritation or pain, loss of vision, abdominal pain, nausea, vomiting, chemical burns, breathing difficulty, chest pain, cough, hypotension, confusion, dizziness, drowsiness, hallucinations, headache, insomnia, irritability, tremor, ataxia, seizures, vision loss, and coma. The objective of this study was to describe pediatric lighter fluid exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. The NEISS database also includes all poisonings and chemical burns to children less than 5 years of age. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. In order to identify lighter fluid exposures among patients age 0–5 years reported during 2000–2020, records with the code 0940 (lighter fluids) in any of the product code fields or the letter combinations "light" and "fluid" in the record narrative were reviewed, and those that appeared to be lighter fluid exposures were included in the study. The distribution of estimated lighter fluid exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.
Results: A total of 418 lighter fluid exposures were identified, resulting in a national estimate of 8937 exposures. The patient age distribution was 301 (3.4%) < 1 year, 5431 (60.8%) 1 year, 2031 (22.7%) 2 years, 733 (8.2%) 3 years, 246 (2.8%) 4 years, and 195 (2.2%) 5 years; 5984 (67.0%) of the patients were male and 2952 (33.0%) female. The patient race was 3426 (38.3%) white, 1661 (18.6%) black/African American, 5 (0.1%) Asian, 998 (11.2%) other, and 2848 (31.9%) not stated. The exposure route was 8444 (94.5%) ingestion, 341 (3.8%) ocular, 312 (3.5%) dermal, 77 (0.9%) inhalation, and 6 (0.1%) unknown. The reported location where the exposure occurred was 7012 (78.5%) home, 58 (0.6%) place of recreation or sports, 17 (0.2%) other public property, 6 (0.1%) street or highway, and 1844 (20.6%) not recorded. The most

commonly reported clinical effects were 1107 (12.4%) cough, 697 (7.8%) vomiting, and 451 (5.0%) pneumonitis. The patient disposition was 6792 (76.0%) treated or examined and released, 232 (2.6%) treated and transferred to another hospital, 1313 (14.7%) treated and admitted for hospitalization, 455 (5.1%) held for observation, 85 (0.9%) left without being seegainst medical advice, and 61 (0.7%) not recorded.
Conclusions: Pediatric lighter fluid exposures treated in EDs most often involved patients who were age 1–2 years and the majority were male. Most exposures occurred by ingestion followed by ocular and dermal contact. Most patients were treated or evaluated and released from the ED.

KEYWORDS Lighter fluid; pediatric; emergency department
Brett.roth@utsouthwestern.edu

149. Pediatric cigarette and cigar exposures treated at emergency departments

Brett Roth[a] and Mathias Forrester[b]
[a]NTPC, UT Southwestern Dallas, Dallas, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Cigarettes and cigars are tobacco products that contain nicotine. Severe adverse reactions have been reported in children with nicotine doses as low as 2 mg. Symptoms reported with pediatric nicotine exposure include vomiting, tachycardia, tachypnea, hypertension, hypotension, agitation, respiratory depression, and seizures. The objective of this study was to describe pediatric cigarette and cigar exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. The NEISS database also includes all poisonings and chemical burns to children less than 5 years of age. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify cigarette and cigar exposures among patients age 0–5 years reported during 2000–2020, records with the letter combination "cig" in the record narrative or the code 1909 (cigarettes, cigars, pipes or tobacco) in any of the product code fields were reviewed, and those that appeared to be cigarette and cigar exposures were included in the study. (Product code 1909 does not appear to have been used by NEISS after 2008.) The distribution of estimated cigarette and cigar exposures was determined for various factors.
Results: A total of 387 cigarette and cigar exposures (380 cigarette, 7 cigar) were identified, resulting in a national estimate of 11,931 exposures. The mean estimated annual number of exposures was 924 during 2000–2008 and 301 during 2009–2020. The estimated number of exposures was 5171 (43.3%) during August-November, 3151 (26.4%) during December-March, and 3609 (30.2%) during April–July. The patient age distribution was 5971 (50.0%) < 1 year, 4991 (41.8%) 1 year, 792 (6.6%) 2 years, 90 (0.8%) 3 years, 0 (0.0%) 4 years, and 86 (0.7%) 5 years; 6889 (57.7%) of the patients were male and 5041 (42.3%) female. The patient race was 6945 (58.2%) white, 1303 (10.9%) black/African American, 16 (0.1%) Asian, 582 (4.9%) other, and 3084 (25.9%) not stated. The exposure route was 11,835 (99.2%) ingestion, 83 (0.7%) nasal, 7 (0.1%) aspiration, and 6 (0.0%) ocular. The location of the incident was 8114 (68.0%) home, 75 (0.6%) place of recreation or sports, 67 (0.6%) street or highway, 15 (0.1%) other public property, and 3659 (30.7%) not recorded. The most frequently documented clinical effects were 1754 (14.7%) vomiting, 300 (2.5%) drowsiness/lethargy, 137 (1.1%) cough/choke, 97 (0.8%) fever, and 94 (0.8%) nausea. The patient disposition was 10,808 (90.6%) treated or examined and released, 131 (1.1%) treated and transferred to another hospital, 190 (1.6%) treated and admitted for hospitalization, 476 (4.0%) held for observation, and 325 (2.7%) left without being seegainst medical advice.
Conclusions: Pediatric cigarette and cigar exposures treated in EDs most often involved patients who were age 0–1 years and the majority were male. Most exposures occurred by ingestion and the majority occurred at home. Most patients were treated or evaluated and released from the ED. A small percentage, 1.6%, were hospitalized.

KEYWORDS Cigarette; pediatric; emergency department
Brett.roth@utsouthwestern.edu

150. High-dose methotrexate toxicity with delayed methotrexate clearance and a laboratory interference of prolonged duration

Audrée Elliott[a], Yves Théoret[b], Maude St Onge[a] and Maxime Nadeau[a]
[a]Quebec Poison Centre, Quebec, Canada; [b]CHU Sainte-Justine, Montreal, Québec, Canada

Background: High-dose methotrexate (HD MTX) induced toxicity can be life-threatening. When the excretion of the drug is delayed in the setting of kidney dysfunction, glucarpidase can be used to eliminate extracellular methotrexate by cleaving it into two noncytotoxic metabolites, DAMPA and glutamate, which are themselves mainly eliminated by the liver. Immunoassays for methotrexate cross-react with DAMPA and consensus guideline as well as the drug monograph estimate an interference of 48 h based on the pharmacokinetics of the metabolite. We present a case of HD MTX induced nephrotoxicity with delayed methotrexate clearance and a persistent falsely elevated MTX concentration on immunoassays.
Case report: A 68 years old man, was treated with methotrexate 7400 mg (3.4 g/m^2) IV infusion over 4 h for a non hodgkin's lymphoma. Blood tests drawn 24 h after methotrexate infusion initiation showed an increased creatinine of 231 μmol/L (baseline 75 μmol/L) and a methotrexate level of 87 μmol/L. Leucovorin calcium was increased to 900 mg/m^2 every 3 h, urine alkalinization was continued and decision was made to order glucarpidase antidote. The patient received glucarpidase 3000 UI (31 UI/kg) IV on day 2. After antidote administration, blood was sent to a specialized remote laboratory to measure methotrexate concentration by high performance liquid chromatography (HPLC) method. We followed and compared the methotrexate concentration measured through different methods to assess the importance of interference that is known to occur with the immunoassays. DAMPA level was measured to assess its impact on the interference. The patient's creatinine's peaked at 487 μmol/L and urine output was preserved. Intravenous leucovorin and urine alkalinization were maintained for a total of 21 days until the methotrexate level reached the target of ≤0.1 μmol/L. The patient presented mild iatrogenic hypervolemia, but did not develop any other sign of toxicity. He fully recovered his renal function 6 weeks later.
Discussion: Using the HPLC-MS/MS as a gold standard, we noted that the methotrexate concentrations measured by immunoassays were falsely elevated up to 11 days following glucarpidase administration, a significant contrast to the 48 h estimation that is recommended. The interference is variable between different immunoassay platforms and is persistent even when DAMPA

concentration is neglectable. Of note, and as suggested by some previous reports, a lower dose of glucarpidase was effective in cleaving almost all of the circulating methotrexate. However, redistribution of the drug and the decreased elimination secondary to nephrotoxicity significantly prolonged the hospital course of the patient.
Conclusions: In selected cases of HD MTX toxicity, glucarpidase rescue can prevent life-threatening complications. Methotrexate concentrations measured through immunoassays can be falsely elevated for more than 10 days after antidote administration. Clinicians should be aware that measurement through a HPLC method might be required beyond the 48 h reported in the consensus guidelines and the drug monograph.

KEYWORDS Methotrexate; glucarpidase; interference

audree.elliott.ciussscn@ssss.gouv.qc.ca

151. N-acetylcysteine for acetaminophen toxicity: a 10-year review of one institution's single-bag protocol

Prashanth Fenn, Avery Michienzi and Nathan Charlton
University of Virginia, Charlottesville, VA, USA

Background: Acetaminophen (APAP) is the most common cause of acute liver failure in the US, however treatment with N-acetylcysteine (NAC) can improve outcomes. In 2006, the Food and Drug Administration (FDA) approved a 3-bag method for intravenous NAC administration. In 2000, prior to this FDA approval, our hospital instituted a single bag intravenous NAC protocol using a standard concentration of 30 g in 1 L of 5% dextrose in water. An initial bolus of 150 mg/kg NAC over 1 h followed by an infusion of 14 mg/kg/h from the same bag is administered by medication pump until discontinued. This is a descriptive study of one hospital's experience with single bag NAC administration for APAP toxicity.
Methods: This was a retrospective chart review of patients treated for acetaminophen toxicity at a single university hospital from January 2011 to October 2021. Cases were identified using Toxicall software which is utilized by the on site regional poison center. Patients were included if they were treated with IV NAC for APAP toxicity using the single bag method. Patients were excluded if they were transferred from another hospital and received a different dosing of NAC, if NAC was being used for non-APAP liver toxicity, or if the patient left against medical advice. Data collected included patient age, clinical outcome, duration of IV NAC, initial and peak acetaminophen, AST, ALT, and INR.
Results: 382 patients were reviewed and 188 patients met inclusion criteria. Patient age ranged from less than 1 year old to 83 years old, with a mean age of 33 years. The mean IV NAC duration was 29.9 h, with a minimum time of less than 1-h, maximum time of 133 h (excluding an outlier at 735 h). There were 105 cases that had IV NAC duration less than the standard FDA approved course of 21 h. The APAP concentrations ranged from <3 to 448 μmol/L with an average 120.9. The average AST/ALT was 560/424 U/L with the maximum recorded AST and ALT at 22988 and 9743 respectively. No patients died or required liver transplant.
Conclusions: Previous studies have shown that the use of single bag NAC minimizes administration errors and carries no increased risk of adverse events. Our hospital has been exclusively using a single bag NAC regimen for over 20 years with a higher maintenance infusion rate (14 mg/kg) than standard FDA dosing. Because of this increased dosing, no adjustments are needed for massive overdoses or for patients receiving hemodialysis. Our chart review reveals favorable outcomes with no deaths and no liver transplants at our hospital over a 10-year period. The study is limited by the exclusion of patients who were transferred to our facility for hepatology evaluation because they received FDA dosing of NAC prior to transfer and by the lack of control group for direct comparison of outcomes. This review provides additional evidence regarding outcomes with the use of the single bag NAC regimen which supports its use and may promote broader adoption into clinical practice by other institutions.

KEYWORDS NAC; single bag; acetaminophen

pgf3hb@virginia.edu

152. Management of pediatric topical fluorouracil (5%) unintentional exposures by US poison centers

Michael Wahl[a], Sarah Berg[b] and Sonya Rashid[b]
[a]Illinois Poison Center, Chicago, IL, USA; [b]Toxikon Consortium, Chicago, IL, USA

Background: Topical fluorouracil (5-FU) cream (5%) is used to treat actinic (solar) keratoses and superficial basal cell carcinoma and comes in 40 gm tubes (2000 mg 5-FU total). Accidental ingestions are a rare occurrence and triage and treatment decisions of oral 5-FU ingestions may be difficult as broadly accepted triage guidance is not available. Oral administration of 5-FU as a solo drug is not used in the systemic treatment of solid tumors due erratic absorption and high rate of clearance. Dihydropyrimidine dehydrogenase (DPYD) in the intestinal wall rapidly metabolizes and inactivates 5-FU prior to absorption. Oral 5-FU prodrugs (e.g., capecitabine) or 5-FU with a DYPD inhibitor (e.g., eniluracil) are used for the treatment of tumors in doses ranging from 500 mg/m^2 to 1250 mg/m^2 BID to bypass intestinal DYPD. There are no cases of fatal overdoses of oral 5-FU alone noted in a PubMed search, however MDX states that fatal doses have occurred in doses of 20–25 mg/kg without specifying route of exposure. 4–5% of people have a deficiency of DYPD and are susceptible significant toxicity at low doses. A research project was undertaken to provide insight on triage, treatment and outcome of unintentional pediatric practices on ingestions of topical 5-FU exposures.
Methods: An NPDS query the product codes for Topical 5-FU preparations exposures for the years 2017–2021 was performed and the results were analyzed for number of exposures, clinical effects and outcomes for exposures in children 5 years old and under.
Results: There were 25 pediatric exposures in the 5 year period queried with 12 female and 13 male patients. 23/25 were managed at home and 2 were referred to an HCF. 7/25 were followed to a known outcome and the remainder were not followed or unable to be followed. There was one case of vomiting that was coded as related. There were 2 exposures with vomiting coded as not related and 2 exposures with diarrhea also codes as not related. There were two cases of dermal irritation/redness that were considered related.
Conclusions: Pediatric ingestions of topical 5-FU cream (5%) are rare occurrences. 5-FU prodrug and 5-FU/eniluracil doses in pediatric cancers start at 500 mg/m^2. A 40 gm tube contains 2000 mg of a drug that is not well absorbed at lower doses and small ingestions will likely not reach clinically significant absorption in patients without DYPD deficiency. National practice appears to treat small dose pediatric exploratory ingestions as non-toxic or minimally toxic. Further surveillance and research will be needed

to further elucidate possible injury in patients with DYPD deficiency. It may be prudent to employ follow-up calls for delayed symptoms as up to 5% of the population has DYPD deficiency.

KEYWORDS Pediatric; fluorouracil; poisoning

mwahl@team-iha.org

153. Prescription stimulants combined with prescription or illicit opioid exposures within the Toxicology Investigators Consortium (ToxIC) Core Registry, January 2012–December 2021

Emily Glidden[a], Desiree Mustaquim[b] and Kim Aldy[c]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]National Network of Public Health Institutes, Atlanta, GA, USA; [b]Centers for Disease Control and Prevention, Atlanta, GA, USA; [c]American College of Medical Toxicology (ACMT), Phoenix, AZ, USA

Background: From 2014 to 2019, the dispensing of prescription stimulants has increased significantly. Because prescription stimulants can be misused and concurrent use of both prescription stimulants and opioids is common among adults with ADHD, it is important to better understand how these drug exposures present in patients treated in healthcare facilities. The present study examined drug exposures involving co-use of prescription stimulants and opioids by demographics and common clinical presentations.
Methods: We examined drug exposures in the Toxicology Investigators Consortium (ToxIC) Core Registry from January 2010 to December 2021, which is a case registry of patients presenting to participating healthcare sites that receive a medical toxicology physician consultation. Drug exposures involving co-use of prescription stimulants and opioids included symptomatic intentional exposure to a prescription stimulant, combined with at least one reported prescription or illicit opioid exposure. Patient demographics and clinical presentations were assessed using descriptive analyses performed in SAS 9.4.
Results: Co-use of prescription stimulants and opioids were identified in 93 exposure cases; 61 (65.6%) involved prescription opioids and 32 (34.4%) involved illicit opioids. Prescription stimulant and prescription opioid exposures most commonly involved males (55.7%), persons aged 15–24 years (26.2%) and non-Hispanic White persons (52.5%). Prescription stimulant and illicit opioid exposures largely involved males (78.1%), persons aged 25–34 (53.1%), and non-Hispanic White persons (46.9%). Sedative-hypnotic syndrome presented with similar proportions in both prescription stimulant and prescription opioid ($n = 13$, 21.3%) and illicit opioid ($n = 6$, 18.8%) exposures, while opioid toxidrome was more common among prescription stimulant and illicit opioid exposures ($n = 9$, 28.1%) than prescription stimulant and prescription opioid exposures ($n = 10$, 16.4%). Sympathomimetic syndrome was also reported ($n = 13$, 14.0%); 9 co-use with prescription opioid (14.8%), 4 co-use with illicit opioids (12.5%). Respiratory depression was reported by more than one in five prescription stimulant and prescription opioid exposures ($n = 13$, 21.3%), while this was reported in 40.6% ($n = 13$) of prescription stimulant and illicit opioid exposures. More than half of prescription stimulant and illicit opioid exposures ($n = 19$, 59.4%) presented with central nervous system (CNS) depression, presenting proportionally more often than prescription stimulant and prescription opioid exposures ($n = 27$, 44.3%). Nearly two in five prescription stimulant and prescription opioid exposures presented with agitation ($n = 24$, 39.3%), presenting proportionally more often than prescription stimulant and illicit opioid exposures ($n = 10$, 31.3%). Nearly all exposures with hyperreflexia involved co-use of prescription stimulants and prescription opioids.
Conclusions: Co-use of prescription stimulants and opioids may complicate clinical presentation of patients receiving care following a toxicological drug exposure. Patients often presented with a range of toxidromes counter to one another including sedative-hypnotic syndrome and opioid toxidrome or sympathomimetic syndrome. Clinical presentations of prescribed stimulant and opioid co-use may mask the effects of one another, thereby complicating both treatment and surveillance efforts by potentially misattributing an incorrect substance contributing to an overdose.

KEYWORDS Toxicology; drug overdose; clinical Presentation

lxi2@cdc.gov

154. Observation time recommendations for hypothetical asymptomatic cases – a survey

Michael Keenan[a], Stephen Rice[a], Meeta Shrivastava[a], Chelsie Jacques[a], Emma Frawley[a], Susan Wojcik[a] and Jeanna Marraffa[a,b]

[a]SUNY Upstate, Syracuse, NY, USA; [b]Upstate NY Poison Center, Syracuse, NY, USA

Background: Fifty-five poison centers across the US managed 2,148,141 human exposures in 2019. Most human exposures are managed at home, with only 30.6% of cases managed at healthcare facilities. Of the cases managed at healthcare facilities, 60.9% were treated and released to home or a psychiatric facility. An important unanswered question is how long to observe these patients that are ultimately discharged from health care facilities. Some xenobiotics require a longer observation period than others due to the possibility of delayed toxicity (e.g., extended-release preparations, sulfonylureas). However, for benign ingestions, it is common for poison centers to recommend 6-h observation. To date, there is limited data on prevalence of specific observation recommendations for asymptomatic individuals.
Methods: A voluntary, anonymous RedCap survey was developed. The survey was sent via email to the poison center director listserv, with a request to distribute the survey to their team. It asked if the respondent was a Specialist in Poison Information (SPI), toxicology fellow, or toxicologist. The survey contained four asymptomatic cases. In our opinion, based on the history, three of the cases required six or more hours of observation. One case was benign by history. The survey asked how long the respondent would observe these patients if consulted through a poison control center. Responses were analyzed using chi-square analysis for variation in recommendations based on level of training.
Results: A total of 151 responses were recorded. The majority (89/151) were SPIs, followed by toxicologists (51/151) and toxicology fellows (6/151). Five respondents did not provide their level of training, and these were excluded from subgroup analysis. Given the small response from the toxicology fellows, these responses were combined with the toxicologists for analysis. For the amitriptyline case, 57.9% of toxicologists and 53.9% of SPIs recommended 6 h of observation from time of ingestion. There was no difference between toxicologists and SPIs ($p = 0.65$). For the ibuprofen case, there was a difference between toxicologists and SPIs, with more toxicologists clearing based on the history (54.4%) and more SPIs recommending 6-h observation from ingestion (50.6%) ($p = 0.03$). For the bupropion case, the most

common recommendation was for 24-h observation from ingestion (68.4% and 65.2% of toxicologists and SPIs, respectively), and there was no difference between toxicologists and SPIs ($p = 0.88$). Finally, there was notable variation in recommendations for the amlodipine case, with recommendations ranging from 6 h post ingestion to 24 h post-emergency department arrival. There was no difference between toxicologists and SPIs ($p = 0.59$).
Conclusions: In general, there was consistency in recommendations between toxicologists and SPIs. An exception to this was the benign ibuprofen ingestion, with toxicologists more likely to clear without a set observation period. Early involvement with a toxicologist for benign ingestions may allow for earlier clearance. Also interesting was the variation in observation recommendation from reported ingestion versus emergency department arrival. Future research could investigate this question in real-world cases.

KEYWORDS Observation; poison control center; asymptomatic

keenanm@upstate.edu

155. Medication lock box distribution to vulnerable patients: a collaboration between a poison center and hospital pharmacy

Jeanna Marraffa[a,c], William Eggleston[b], Christina Phelan[c], Taylor Hoige[c], Vincent Calleo[c] and Christine Stork[c]

[a]Upstate NY Poison Center, Syracuse, NY, USA; [b]Binghamton University School of Pharmacy and Pharmaceutical Sciences, Binghamton, NY, USA; [c]SUNY Upstate Medical University, Syracuse, NY, USA

Background: Pediatric exposure to xenobiotics is a preventable cause of injury. Poison control centers receive over 900,000 calls annually for children less than 6 years of age. Less than 10% of people report storing medications in a secure or locked location. More concerning, only 32.6% and 11.7% of homes with young children and older children, respectively, report safe storage of opioid medications, which represent the largest category of unintentional poisoning deaths in the US.
Methods: In late 2019, the poison center and hospital pharmacy at a large tertiary-care center received funding and implemented a pilot program to provide medication lock boxes and medication safety teaching to a subset of patients/caregivers discharged from our hospital. Since inception, we have received 4 separate grants to fund this project. Lock boxes are offered to caregivers of pediatric patients (<18) who present to the hospital after intentional or unintentional poisoning. Medication safety cards with the poison center number were provided with the lock box distribution, and trained professionals demonstrated proper lock-box use. A brief survey was requested to be returned with a self-addressed envelope in 3 months.
Results: 633 lockboxes have been distributed. The survey response rate is low (3%) and information regarding the use and/or efficacy of the lockboxes cannot be extrapolated. In the surveys returned, all respondents report continued use of the medication lock box 3 months after receiving it. We did not track hospitalization rates in the patients that received a lock box.
Conclusions: There is little data evaluating the utilization of medication lock boxes as a tool to prevent unintentional exposures in children less than 6 years of age in the US. However, having one additional tool available, such as a lock box, may decrease unintentional exposures. This data preliminarily shows that caregivers are willing to use a locked storage device. Unfortunately, our response rate from the distribution of lock-boxes in hospitalized patients is low. However, we feel that giving lock boxes provides an additional layer of protection to our most vulnerable patients. Next steps include identifying mechanisms to improve survey return rate, securing more stable funding sources, and increasing access to the program to reach more at-risk patients. This program demonstrates the feasibility of using this model to identify appropriate, at-risk patients to distribute medication lockboxes. We present what we believe is a unique collaborative project with a single poison center and hospital pharmacy to distribute medication lock boxes and provide medication safety training to prevent unintentional poisonings.

KEYWORDS Public health; medication safety; poison prevention

marraffj@upstate.edu

156. Utility of pre four-hour iron concentration in predicting toxicology

Haley Fox[a], Abigail Jansen[b], Jillian Theobald[a], Matt Stanton[a] and Ryan Feldman[a]

[a]Froedtert and the Medical College of Wisconsin, Milwaukee, WI, USA; [b]Mayo Clinic, Rochester, MN, USA

Background: Peak iron concentrations can be used to assess potential for toxicity. It is generally recommended that an iron concentration is obtained between four and 6 h after exposure to ensure adequate absorption time and the concentration represents a true peak. Despite this, many potential iron overdoses have concentrations drawn immediately upon patient presentation. The utility of a pre six-four iron concentration in assessing risk of exposure is not clear. The purpose of this study is to determine if iron concentrations at or prior to 4 h predict the need for antidotal therapy or a potentially toxic future iron concentration.
Methods: This is a single-center, retrospective study of patient cases with primary ingestion of oral iron reported to a Regional Poison Center (RPC) from January 1, 2015 to January 1, 2020. Patients were excluded if only a single iron concentration was obtained/documented, no concentrations were obtained after 4 h, or IV iron was responsible for overdose. The primary outcome is the incidence of antidotal deferoxamine administration. Secondary outcomes include the incidence of an iron concentration of 500 mcg/dL or greater at or beyond 4 h associated with a concentration of <200 mcg/dL prior to 4 h.
Results: A total of 132 patients were included in this study, 93 patients had an intentional ingestion and 39 patients had an unintentional ingestion of iron. Deferoxamine was used to treat six patients; all of these patients had an intentional ingestion and a concentration of >300 mcg/dL at or prior to 4 h post-ingestion. No patients with a concentration <300 mcg/dL at or prior to 4 h required treatment with deferoxamine (negative predictive value [NPV] 100%). Only two patients had a documented concentration of >500 after 6 h, both patients had an initial concentration of >450 at or prior to 4 h.
Conclusions: An iron concentration of 300 mcg/dL before 4 h may be adequate in ruling out potential toxicity. In this case series, a pre-4 h level of 300 mcg/dL or less was the ideal cutoff to predicting the need for antidotal therapy, with a sensitivity of 100% and a specificity of 64.4%. Limitations of this study include being a single-center, retrospective review, passive reporting reliance on caller information.

KEYWORDS Iron; concentration; management

haley.fox@froedtert.com

157. Pediatric exposures to *Mitragyna speciosa* (Kratom)

Matthew Novak and Michael Wahl
Illinois Poison Center, Chicago, IL, USA

Background: Previous research has shown a significant increase in Kratom exposures reported to regional poison centers, particularly since 2016. There is however little research on pediatric exposures to Kratom.
Methods: A retrospective review of the National Poison Data System (NPDS) January 1st 2017 to December 31, 2021 for exposures with the generic NPDS code for Kratom in children ages 5 years and younger was conducted.
Results: A total of 267 cases were identified; 134 (50.2%) female patients, 132 (49.4%) male, and 1 (0.4%) patient's gender was unknown. The most common patient age was 1 year old 114 (42.9%), 2 years old 63 (23.7%), and <1 year old 54 (20.3%). The vast majority of cases were ingestions 257 (96.2%) with the remainder being dermal 8, unknown 3, other 2, and inhalation 1. Nearly all exposures were unintentional general 253 (94.7%) with other reasons including unknown reason 3, adverse reaction drug 2, and unintentional therapeutic error 1. Pediatric exposures increased from 7 in 2017 to 92 in 2021, an increase of 1314%. A total of 7 cases were excluded as exposures due to being confirmed non exposures. Of the remaining 260 exposures, 7 (2.7%) patients were coded to have a serious outcome. There were 0 fatalities during this time period. The most common symptoms coded were vomiting 17, central nervous system (CNS) depression mild 7, and agitation 5. More serious symptoms coded were confusion, CNS depression moderate, CNS depression major, respiratory depression, tremor, hallucinations, seizures multiple, and seizures status. The most common treatments coded were dilute/wash/irrigate 70, food/snack 34, single dose activated charcoal 9, intravenous fluids 8, and other emetics 7. Other important therapies reported as being administered included benzodiazepines 2, naloxone 2, anticonvulsants 1, and oxygen 1. No therapy was coded in 171 (64%) possible cases.
Conclusions: In a 5-year retrospective review of NPDS data, exposures to Kratom dramatically increased by 1314% from 2017 to 2021. The majority of patients did well developing no or only minor symptoms and were managed with simple first aid triage instructions. C There has been an increase in pediatric Kratom cases managed by the US Poison Centers over the past 5 years. Most cases have no or minimal effects, however serious toxicity can occur in a minority of cases. Close follow up for home managed cases is recommended and referral to an emergency department for symptomatic patients may be prudent. Further research is needed to better determine characteristics of exposure in this age group and prevention education opportunities.

KEYWORDS Kratom; mitragyna speciosa; pediatric

mnovak@team-iha.org

158. Life threatening cardiac dysrhythmia secondary to taxine toxicity successfully managed with VA ECMO

Madelyn Lebin[a], Cali Lunowa[a] and Jacob A. Lebin[b]
[a]Skaggs School of Pharmacy, University of Colorado, Aurora, CO, USA; [b]Department of Emergency Medicine, Washington Poison Center, University of Colorado, Aurora, CO, USA

Background: Taxine alkaloids, collectively known as taxines, are the toxic constituents found in the needles, berries, and bark of the yew tree (*Taxus spp.*). When ingested in large quantities, the alkaloids alter sodium and calcium ion channel permeability resulting in cardiotoxicity. Previously reported cardiac dysrhythmias have been refractory to supportive measures, making the ingestion difficult to manage. We describe a case of life-threatening cardiac dysrhythmia due to taxine toxicity that was successfully managed with veno-arterial extracorporeal membrane oxygenation (VA ECMO).
Case report: This is a single patient chart review. Emergency medical services (EMS) were called to the home of a 22-year-old woman who reported severe vomiting following an intentional ingestion of yew needles purchased online. Upon EMS arrival the patient had witnessed seizure-like activity with associated polymorphic ventricular tachycardia. ECG demonstrated alternating wide complex bradycardia and pulseless ventricular tachycardia. Both prehospital and emergency department resuscitation efforts were extensive, including multiple doses of intravenous calcium, magnesium, epinephrine, sodium bicarbonate, lidocaine, and amiodarone, with minimal improvement in patient status. The patient continued to have life-threatening dysrhythmias which prompted intubation and the use of intravenous lipid emulsion 20% with brief return of spontaneous circulation. Once in the intensive care unit, the patient had increasing vasopressor requirements with rising serum lactate. She subsequently had another episode of pulseless ventricular tachycardia and was transferred to a tertiary care center for VA ECMO. The patient was maintained on VA ECMO for 4 days, ultimately converting to sinus rhythm. She underwent stepwise de-escalation of intervention with minimal residual cognitive or motor deficits.
Discussion: Large taxine ingestions portend high mortality as few interventions have demonstrated reproducible efficacy. Taxine alkaloids are thought to mediate toxicity via sodium and calcium channel blockade with typical toxic manifestations of severe vomiting, seizures, and refractory wide complex dysthymias. Previous reports have described the use of sodium bicarbonate and lidocaine to overcome sodium channel blockade, similar to the management of tricyclic antidepressant toxicity, but its efficacy has not been clearly demonstrated. Lipid emulsion remains a last line option, and while temporally successful in this case, it is unclear if the efficacy can be attributed solely to the lipid emulsion or to the collective effect of all treatment interventions. As in this case, refractory cases of taxine toxicity have been successfully managed with VA ECMO. This case adds to the growing body of literature that rapid initiation of VA ECMO may be beneficial for patients suffering from refractory taxine-induced cardiotoxicity.
Conclusions: Early transfer to a VA ECMO capable center should be considered in the setting of life-threatening taxine toxicity associated with refractory cardiac dysrhythmias.

KEYWORDS Yew; cardiotoxicity; VA ECMO

madelyn.lebin@cuanschutz.edu

159. Successful management and endoscopic retrieval of body stuffer

Zachary Oliff[a], Muhammad Akbar Baig[b] and Joshua Nogar[b]
[a]Northwell Health, Manhasset, NY, USA; [b]NorthShore University Hospital, Manhsasset, NY, USA

Background: The internal concealment of xenobiotics poses diagnostic and therapeutic challenges for medical and public health practitioners. Body packers tend to conceal or ingest a xenobiotic to avoid detection. These xenobiotics are often

concealed in an unplanned manner and tend to be poorly wrapped. This heterogeneity in packaging material, as well as xenobiotic concealed, pose unique challenges regarding potential retrieval and degree of toxicity.
Case report: This is a single patient chart review. A 30-year-old male presented to the Emergency Department after ingesting a plastic bag containing 15 tablets of MDMA (3,4-Methylenedioxymethamphetamine). The patient was under arrest by police and ingested the package in an attempt to avoid detection. The patient presented to the Emergency Department with stable vital signs and only reporting mild anxiety. He received plain films of his abdomen, which revealed a potential foreign body. A subsequent CT abdomen and pelvis revealed multiple foreign bodies in the area of his gastric fundus. The patient was admitted to the hospital for continuous monitoring and potential retrieval of the package. The patient had repeat plain films 6 h into his stay, which revealed that the foreign body had not progressed. Gastroenterology was consulted and the patient underwent successful endoscopic retrieval of the plastic bag with contents. Repeat plain films showed no retained foreign bodies and patient was discharged in stable condition.
Discussion: The potential interventions for body stuffers are limited and each has potential pitfalls. Whole bowel irrigation can result in rupture of contents and is no guarantee that the product ingested will pass. Similar patients can potentially take up hospital and critical care beds for prolonged periods of time while awaiting the passage of xenobiotic packages. When endoscopic retrieval is an option, it can greatly decrease the length of stay of a patient in a safe, effective manner.
Conclusions: Body stuffers pose unique challenges to medical toxicologists regarding monitoring and potential retrieval of ingested xenobiotics. Endoscopy and retrieval can be useful and potentially decrease length of stay in these patients.

KEYWORDS Body stuffer; MDMA; endoscopy

zachary.oliff01@gmail.com

160. The importance of emphasizing addiction medicine during medical toxicology fellowship training: a case study of a tertiary care hospital system toxicology consultation service

Nicholas Imperato, Chase Jones, Derek Fikse, Gillian Beauchamp, Marna Greenberg, Katelyn McLain and Alexandra Amaducci

Lehigh Valley Health Network/USF Morsani College of Medicine, Allentown, PA, USA

Background: As we continue to treat patients during the ongoing opioid overdose epidemic, it is ever more important that providers have adequate experience in understanding and treating patients with addiction, substance use disorder and withdrawal states. Additionally, throughout the COVID-19 pandemic, there have been numerous reports demonstrating that substance use is exponentially increasing. This increases the likelihood that addiction medicine will occupy a more prominent position in our medical field. Until recently, addiction medicine education was not an ACGME program requirement for medical toxicology fellowship programs. We aimed to evaluate the percentage of bedside medical toxicology consultations addressing addiction-related issues, over time, at a tertiary care hospital system.
Methods: We reviewed bedside toxicology consults performed by a tertiary care hospital system's Division of Medical Toxicology consultation service between January 2017 and December 2021 for addiction, substance use, and withdrawal-related cases. Consultation data is entered by bedside toxicologists and maintained in a secure database. Descriptive statistics were analyzed for various variables and were compared between years, utilizing SPSS28.
Results: Over the 5-year period, the toxicology service was consulted on a total of 4733 patients, of which, 2549 were addiction-related (53.9%). The majority of consults were male (65.6%), with 1 transgender (male-to-female) patient treated during this time. The proportion of addiction medicine consults increased steadily over the five-year time period. In 2017, there were 345 total consults, with 88 addiction-related (25.5%). In 2018, the service was consulted on 509 patients, of which 168 were addiction related (33%). In 2019, this trend continued to increase, with addiction medicine consults accounting for 52.8% of the total consults (478 of 905 consults). 58.7% of the toxicology services' consults were addiction related in 2020 (627 of 1069). As of this past year, of the 1905 total consults, 1188 were for addiction or substance-use complaints (62.4%). The most common primary reason for a medical toxicologist consult, was alcohol withdrawal (803 cases, 31.5%). In 2021, alcohol withdrawal accounted for 44.2% of the total consults, which was a 25.7% increase from pre-pandemic levels. Opioid withdrawal as the primary reason for consultation accounted for 9.1% of total consults across the time-period. In 2017, opioid withdrawal accounted for 2.3% of consults, but increased to 13.0% of the consultations by 2021. Opioid agonist therapy (buprenorphine, methadone) was initiated in 12.7% of total consults. In 2017, there were no cases where opioid agonist therapy was a topic of consultation, but this increased to 12.0% of consults throughout 2021.
Conclusions: At a tertiary care hospital system, addiction medicine consults by bedside medical toxicologists have continued to increase disproportionately compared to other consults. As of this past year, addiction related complaints made up roughly two-thirds of all medical toxicology consults, increasing almost 40% over 5-years. This single center phenomenon could represent a national trend; however, larger-scale studies would need to assess this pattern. This data further supports the recent ACGME medical toxicology program requirement changes, emphasizing the importance of addiction medicine and its relationship to medical toxicology.

KEYWORDS Addiction medicine; public trends; medical education

nicholas.imperato@lvhn.org

161. Intentional self-harm overdoses before and during the COVID-19 pandemic in adolescents managed by a medical toxicology consultation service

Samantha Gaetani, Natalie Ebeling-Koning, Nicholas Imperato, Katelyn McLain, Derek Fikse, Gillian Beauchamp, Marna Greenberg and Alexandra Amaducc

Lehigh Valley Health Network/USF Morsani College of Medicine, Allentown, PA, USA

Background: Since March 2020 to the present, the world has been coping with the COVID-19 pandemic and the associated social ramifications. It has impacted community mental health, with several studies demonstrating an increase in anxiety and depression among adults and adolescents during the pandemic. The reasons are multifactorial, however, may be related to a decrease in access to outpatient appointments, social distancing, financial hardships, loss of loved ones, and closures of schools,

jobs, and recreational activities. We aimed to review adolescent intentional self-harm overdose cases presenting to our tertiary care hospital system's medical toxicology consultation service prior to and during the pandemic.
Methods: We reviewed bedside medical toxicology consultations from May 2018–February 2020 (22 months pre-COVID-19) and March 2020–December 2021 (22 months during COVID-19) for self-harm cases in adolescents ages 10–19 years old. Descriptive analysis was performed on these groups for variables including number of self-harm cases, number of intentional overdoses, age, sex, and primary agent used.
Results: The total number of intentional ingestions in adolescents 10–19 years old from May of 2018-December of 2021 was 396: there were 174 cases between May 2018-February 2020 with 95 cases (54.5%) being self-harm cases, and 222 cases between March 2020-December 2021 with 145 (65.3%) cases being self-harm cases. Of the 95 intentional self-harm overdoses in the pre-COVID-19 timeframe, analgesics were the most commonly used medication class ($n = 29$; 30.5%). Analgesic medications included acetaminophen, aspirin, and ibuprofen. Acetaminophen was the most commonly used medication for overdose from May of 2018–February 2020 ($n = 21$; 23.1%). Antidepressants were the next largest group of medications used ($n = 13$; 27.4%). The other overdose xenobiotics pre-COVID-19 were anticonvulsants ($n = 5$; 5.3%), anticholinergic/antihistamine ($n = 13$; 13.7%), antimicrobials ($n = 2$; 2.1%), antipsychotics ($n = 8$; 8.4%), cardiovascular medications ($n = 4$; 4.2%), lithium ($n = 1$), iron ($n = 1$), opioids ($n = 1$), and sedatives-hypnotics ($n = 5$; 5.3%). In the pre-COVID19 time period, cases were 84.2% female ($n = 80$), 13.7% male ($n = 13$), and 2.1% ($n = 2$) transgender (male-to-female, female-to-male, and gender non-conforming). In the 145 self-harm cases during the COVID-19 timeframe, analgesics were most commonly used ($n = 47$; 32.4%), and acetaminophen was the most common medication used overall ($n = 35$; 24.1%). Antidepressants were involved in 31% ($n = 45$). Other agents were ethanol ($n = 1$), methanol ($n = 1$), anticholinergic/antihistamine ($n = 1$), anticonvulsants ($n = 8$; 5.5%), antimicrobials ($n = 1$), antipsychotics ($n = 6$; 4.1%), cardiovascular medications ($n = 8$; 5.5%), caustic ($n = 1$), dextromethorphan ($n = 1$), lithium ($n = 2$; 1.4%), opioids ($n = 3$; 2.1%), sedative hypnotics ($n = 5$; 3.4%), and sympathomimetics ($n = 2$; 1.4%). Out of this group, 78.6% ($n = 114$) were female, 16.6% ($n = 24$) were male, and 4.8% ($n = 7$) were transgender.
Conclusions: In the COVID-19 time period, there was an increase in self-harm cases and intentional overdoses. The most common medications used for intentional overdose during both time periods were analgesics and antidepressants, with the most commonly used agent being acetaminophen. The majority of intentional self-harm cases were among females. Future research could focus on larger scale epidemiological data on self-harm overdoses to determine the impact of the pandemic on mental health.

KEYWORDS Intentional overdose; adolescent; COVID

Samantha.gaetani@lvhn.org

162. Poison center penetrance, utilization, and call distribution 2016–2020

Hayley Gartner, Adam Overberg and Shannon Penfound

Indiana University Health/Indiana Poison Center, Indianapolis, IN, USA

Background: Poison center utilization has been associated with decreased emergency department visits, hospitalization rates, and total healthcare expenditure. Assessment of poison center utilization is necessary to increase public awareness and promote effective outreach. This study aims to describe utilization trends and county changes in call volume over time. Penetrance as a measure of poison center utilization is the annual rate of human exposure calls per population and varies by many social, economic, and geographic factors. Geospatial mapping and analysis of penetrance may reveal poison center underutilization and identify areas for targeted outreach.
Methods: A single-center, retrospective study of closed, human exposure calls to a poison center was conducted between January 1, 2016, and December 31, 2020. Patient demographics included age, gender, medical outcomes, and exposure reason. Penetrance was assessed by cross-linking poison center data with county-level population statistics from the US Census Data. Linked data were stratified by adult, elderly, and pediatric subsets. Percent change of county-level call volume and county-level penetrance was assessed over 1-year and 5-year periods and geospatially visualized using Quantum Geographic Information System (QGIS).
Results: Of the 92 state counties, 14 counties had a decrease in penetrance of greater than 20% between 2019 and 2020 compared to 6 counties in 2018 and 2019. A total of 8 counties had an increase in penetrance of greater than 15% from 2018 to 2019 compared to 27 counties in 2019 and 2020. Overall, data demonstrated a decreased number of calls between 2016 and 2020. Decreases were consistent across all age groups over time ($p < 0.001$). Contrarily, increased admissions to psychiatric care and noncritical care units were found. Medical outcome analysis revealed an increase in major effects and a decrease in the number of minor effects over time.
Conclusions: Poison center penetrance is variable by geographic location. Future studies should include an assessment of county socioeconomic and demographic variables. Understanding the distribution of poison center calls is essential for improving resource allocation and increasing poison center access across the state.

KEYWORDS Utilization; penetrance; center

hgartner@butler.edu

163. Minimal recovery of drug from extracorporeal treatment in a case of phenytoin toxicity associated with coma and hypothermia

Joshua Bloom[a], Ami Desai Gadiraju[b], Amol Mittal[b], Robert S. Hoffman[c] and Mark Su[c]

[a]Division of Medical Toxicology, NYU Grossman School of Medicine, New York, NY, USA; [b]Department of Internal Medicine, White Plains Hospital, White Plains, NY, USA; [c]NYC Poison Center, New York, NY, USA

Background: The Extracorporeal Treatments in Poisoning (EXTRIP) workgroup provides a weak conditional recommendation in support of hemodialysis (HD) for select patients with severe phenytoin poisoning. Despite this recommendation, the HD clearance of phenytoin is poorly studied. We present a patient who developed phenytoin toxicity that was treated with hemodialysis and report on the efficacy of phenytoin removal during HD.
Case report: An 87-year-old man with epilepsy who was maintained on a stable dose of 300 mg phenytoin extended-release daily was admitted to the hospital for treatment of Coronavirus Disease 2019 and congestive heart failure. On hospital day 14, the patient had a gradual onset of depressed mental status with

hypothermia (nadir 35 degrees Celsius). At this time, he had a rising total blood phenytoin concentration (peak 49.3 mcg/mL [therapeutic 10–20 mcg/mL] with an albumin of 3.8 g/dL [normal 3.4–5.4 g/dL]). The patient's other medications included furosemide, aspirin, atorvastatin, digoxin, doxycycline, metoprolol tartrate, and warfarin; he was also receiving albumin and crystalloid for hypovolemia (albumin nadir on hospital day 14: 2.5 g/dL). Free phenytoin concentrations were not available. Alternate etiologies of hypothermia (endocrine, infectious) were excluded. The Poison Control Center was consulted and recommended HD because of the concern for prolonged coma, as per EXTRIP guidelines. The patient received three sessions of HD over a period of 6 days at 2.5–3 h per session using an F160 Optiflux membrane filter (Fresenius Medical Care, Waltham, MA, USA), with a blood flow rate of 350 mL/min and a dialysate flow rate of 700 mL/min. After the first session of HD (2.5 h) on hospital day 21, his hypothermia resolved and his phenytoin concentration fell from 39.2 mcg/mL to 34.2 mcg/mL with only mild improvement in his mental status. After 6 days (hospital day 27), his phenytoin concentration decreased to 19.5 mcg/mL and his mental status normalized. Effluent from the first HD session had phenytoin concentrations below the limit of detection (0.50 mcg/mL). Thus, no greater than 52 mg of phenytoin was removed during a 2.5-h session of hemodialysis.

Discussion: The reason for the sudden increase in blood phenytoin concentrations in this patient is unclear in the absence of drug-drug interactions or dosing changes to the phenytoin. Although uncommonly reported, patients with phenytoin toxicity can experience hypothermia. In this case, the patient's hypothermia resolved during HD, although it is unclear if this was related to changes in phenytoin concentration or (more likely) direct extracorporeal warming via the HD machine. If the patient's phenytoin clearance from the first session were extrapolated to subsequent sessions an estimated maximum of 166.4 mg of phenytoin would be removed in 8 total hours of HD, which is far less than previously reported phenytoin clearances on the order of grams. This difference may be related to the use of high cutoff dialysis membranes in prior studies, which are not routinely used.

Conclusions: Although HD rapidly resolved this patient's hypothermia, a minimal amount of phenytoin was recovered in the patient's dialysate. Prior studies suggesting consequential clearance and efficacy of phenytoin removal by extracorporeal treatment may not apply to routine HD methods. Further studies on the utility of extracorporeal treatment for phenytoin toxicity are needed.

KEYWORDS Phenytoin; hemodialysis; extracorporeal treatment

joshua.bloom@nyulangone.org

164. Province-wide school closures and poison centre calls for pediatric intentional self-harm

Emily Austin[a], Sara Khan[b], Jacquline Burke[a], Crisalina Amiana[a], Olwen Tennis[a], Mabel Chan[a], Allison Davis[a] and Jonathan Zipursky[c]

[a]Ontario Poison Centre, Toronto, Canada; [b]Health Canada, Ottawa, Canada; [c]Department of Medicine, University of Toronto, Toronto, Canada

Background: School closures were one public health strategy employed to mitigate community transmission of the SARS-CoV-2 virus. During the pandemic, public schools in Ontario were closed longer than any other province in Canada. There have been increased mental health concerns among school-aged children during the COVID-19 pandemic. Whether school closures contributed to worse mental health among Ontario youth is currently unknown. To determine if province-wide school closures in Ontario during the COVID-19 pandemic were associated with increases in intentional self-harm calls to our poison centre among school-aged children.

Methods: We performed a cross-sectional analysis of calls received to our poison centre between February 2017 to January 2022. We identified consultation requests for intentional human exposures for individuals 6–19 years. We excluded calls for individuals outside this age range as well as those calls for exposures identified as unintentional, malicious, or due to tampering. We calculated weekly incidence of calls to the poison centre during each period. We used univariate tests to compare the mean weekly rate of calls during each of the three province-wide school-closure periods Closure #1 (March 23–June 30, 2020), Closure # 2 (April 12–June 30, 2021), Closure #3 (January 3–17, 2022) to the rate in the corresponding period from 2017 to 2019 (control period). To examine the severity of intentional exposures we also compared the percentage of calls coded as having a death or a major outcome during school closures to the corresponding control time periods.

Results: There was an overall decrease in the weekly number of calls for intentional self-harm observed during the first school closure at the onset of the COVID-19 pandemic in 2020. A similar decrease was not observed during the second province-wide school closure, which occurred in Spring 2021. Moreover, the mean weekly rate of intentional calls was lower during the first school closure than in the control period (76.2 v. 111.6, $p < 0.01$). There were no differences in the mean weekly rate of intentional calls during the second school closure (117.1 v. 110.0, $p = 0.25$) and third school closure (106.5 v. 105.0, $p = 0.89$) compared to their respective control periods. There were also no significant differences in the proportion of intentional exposures coded as severe (death or major outcome) during school closures as compared to the control periods.

Conclusions: Province-wide school closures during the COVID-19 pandemic were not associated with an increase in intentional self-harm exposure calls to our poison centre in school-aged children. Our findings build upon previous studies demonstrating no overall increases in self-harm and overdose among adolescents during the first year of the pandemic. The decrease in calls observed during the first school closure may have been related to mass distraction owing to significant uncertainty from an unexpected global pandemic. Similar decreases in self-harm have been observed during other major global events.

KEYWORDS School closures; pediatric self-harm; COVID-19

eaustin0@gmail.com

165. Pediatric edible cannabis exposures before and after statewide packaging legislation

Faisal Minhaj[a], James Leonard[b], Elizabeth Hines[c], Bruce Anderson[d] and Wendy Klein-Schwartz[e]

[a]Wellstar Kennestone Hospital, Atlanta, GA, USA; [b]Maryland Poison Center, Baltimore, MD, USA; [c]School of Medicine, University of Maryland, Baltimore, MD, USA; [d]School of Pharmacy, University of Maryland, Ellicott City, MD, USA; [e]School of Pharmacy, University of Maryland, Baltimore, MD, USA

Background: The state medical cannabis commission (SMCC) is the governing body to regulate medical cannabis products. Before April 2021, edible cannabis products were not regulated until final legislation was promulgated. After April 19, 2021, all new edible cannabis products had to abide by regulations that limited edible products to 10 mg/dose and 100 mg/package.

These packages were required to be child resistant, tamper evident, and approved by the SMCC. Any products produced prior to this date had 90 days to comply with the new regulations. The objective of this study is to examine the number of reports to the regional poison control center before and after the new package legislation was implemented.
Methods: This is an interim analysis of a prospective observational study of edible cannabis exposures in children <12 years. In anticipation of legislative changes, a data collection tool was instituted in January 2020 to prospectively collect data on pediatric cannabis exposures including demographics, product descriptions and doses, disposition, and outcomes. The pre-implementation group is defined as exposures from January 2020–July 2021. The post-implementation group are exposures from August 2021–March 2022. Descriptive analyses were performed.
Results: A total of 127 exposures were reported during the time frame, 87 in the pre-implementation period and 40 in the post-implementation period. Adjusted for time, there were 4.6 exposures/month in the pre-implementation period and 5.0 exposures/month in the post-implementation period. Median age of exposure was 4 years (IQR 2 – 6) and was equally distributed between boys and girls (49% vs 51%). Moderate effect was seen most often (33%), followed by not followed (30%), minor (23%), no effect (9%), and major effect (5%). Of those who were evaluated in a healthcare facility, most (57%) were treated, evaluated, and released, although 11% were admitted to a critical care unit and 7% to a noncritical care unit. Approximately 25% refused referral or did not arrive to the healthcare facility. Of known products, the most common were gummies (64%), followed by baked goods (17%), and candy (16%). How the product was stored, or how the child had access to the product was missing in most cases (61%). This was similar for the source of the product (unknown in 67%). Of the known sources, most products were commercially manufactured (93%) with the rest being homemade. Only in three instances was it noted that the product was in a child-resistant container.
Conclusions: The rate of edible cannabis exposures per month following implementation of packaging restrictions did not appear to change. Further analyses need to be assessed on whether the dose restrictions decreased severity of outcomes. Manufacturing regulations implemented by the SMCC are important, but it is unclear if they are being followed. Enforcing packaging requirements and educating consumers on proper storage may help to limit future exposures.

KEYWORDS Cannabis; public health; poison center

Faisal.Minhaj1@gmail.com

166. Increasing poison center case severity as measured by number of follow-up calls per case

Edward Bottei

Iowa Poison Center, Sioux City, IA, USA

Background: Over the past decade, there has been a feeling among poison control center (PCC) personnel that their exposure cases have become more severe. With increasing severity of the exposure, the patient stays in the ICU and/or hospital for a longer period and the specialists in poison information (SPIs) do more follow-up calls (call backs) to assist with management and to determine the eventual outcome.
Methods: The average number of call backs per exposure case was determined using only our poison center data since our guidelines for when to close a case (i.e., when to stop making follow-up calls) has been consistent for the past 15+ years. The frequency of call backs is determined by each individual SPI based on the severity of the ingestion and the patient's stability. Two time periods were compared, 2011–2013 (Period 1) and 2019–2021 (Period 2). The average number of call backs per exposure case during each 3-year period was calculated by determining the total number of call backs made in the 3 years divided by the total number of exposure cases. The total number of call backs was found by summing up the number of call backs per case times the number of cases with that many call backs (e.g., 3 call backs per case times 1000 cases with 3 call backs equals 3000 total call backs).
Results: During Period 1 there were a total of 41,623 exposure cases and a total of 108,116 call backs made, yielding an average of 2.60 (95% C.I. 2.59–2.63) call backs per case. During Period 2 there were a total of 38,675 exposure cases with a total of 119,437 call backs made, yielding an average of 3.09 (95% C.I. 3.05–3.12) call backs per case. The mean difference between Period 1 and Period 2 is 0.49 (95% C.I. 0.44–0.53) call backs per exposure case ($p < 0.00001$).
Conclusions: A great many PCC exposure cases have negligible toxicity and are closed without the need for a call back. In the past few years, the severity of ingestions has appeared to increase from ingestions of a greater number of tablets (particularly APAP, diphenhydramine and other OTC medications) or from larger ingestions of medications causing end-organ instability (e.g., shock, respiratory failure, seizures, coma, etc). As case severity and complexity increase, so does the amount of time the SPIs invest on each exposure case. The increased time expenditure can be in the form of calls of longer duration, more call backs per case, more time charting or more time consulting with a toxicologist. This study shows a significant increase in the number of call backs per exposure case between the two time periods studied. The total number of call backs increased by 11,321 from Period 1 to Period 2 despite the number of exposure calls decreasing by 2948 between the two periods. One possible explanation for our findings is that with fewer exposure cases the SPIs have more time to do more call backs. This is unlikely in our PCC for three reasons. First, our PCC's guidelines for over 15 years has been to only call back if there is new information to gather or new recommendations to provide. Second, the health care providers regularly call the PCC when there are changes in the patient's condition. Third, there is a conscious effort to minimize call backs so as not to monopolize the health care providers' time. PCC exposure case severity has increased as evidenced by a significant increase in the number of follow up calls made per case.

KEYWORDS Exposure case severity; poison center follow up calls; SPI time use

tamera.snyder@unitypoint.org

167. Insulin concentrations following termination of high dose insulin euglycemic therapy

Brian Wiener[a], Cameron T Smith[b], Savan Patel[a] and Robert S. Hoffman[a]

[a]Division of Medical Toxicology, Ronald O Perelman Department of Emergency Medicine, NYU Grossman School of Medicine, New York, NY, USA; [b]Division Critical Care Medicine, New York City Health + Hospitals/Bellevue, New York, NY, USA

Background: High dose insulin euglycemic therapy (HIE) is used to treat patients with calcium channel blocker and beta-adrenergic antagonist overdoses. However, the pharmacokinetics of insulin is largely unknown following cessation of administration of supra-physiologic insulin doses for prolonged periods of time.

More data is needed to understand insulin elimination, both to identify the length of efficacy and to predict the duration of hypoglycemic risk. We report serial insulin concentrations following the termination of HIE.

Case report: A 50-year-old woman overdosed on 150 mg of amlodipine and became hypotensive. After unsuccessful therapy with calcium gluconate and norepinephrine, HIE was added to her regimen. For 54 h the patient's HIE dose was set at 2 units per kilogram per hour. Throughout her entire hospital course, this patient had normal kidney function with a peak creatinine concentration of 0.7 mg/dL and an estimated GFR greater than 60 mL/min. The patient had a favorable outcome, survived without obvious sequelae, and was able to first be weaned off norepinephrine and then off HIE. Following termination of HIE, we collected serum insulin concentrations every 4 h in an attempt to evaluate insulin clearance. The serum insulin concentrations remained above physiological ranges for greater than 48 h after HIE was stopped. Notably, insulin concentrations remained above 1000 μU/mL (reference range 2.6 to 24.9 μU/mL) for greater than 4 h and above 300 μU/mL for greater than 8 h. A decline to normal physiological concentrations occurred over more than 48 h. From 8 to 64 h after the infusion was stopped, concentrations fell with apparent first-order elimination (R^2 of 0.93) and a half-life ($T^1/_2$) of 12.95 h.

Conclusions: In this patient with normal kidney function, insulin concentrations fell with an apparent $T^1/_2$ of 12.95 h following termination of HIE. Even in the presence of normal perfusion and preserved kidney function, this $T^1/_2$ is far greater than typically reported with low dose insulin infusions. It is unclear whether this apparent prolonged elimination half-life is secondary to deep tissue storage, a saturable component of elimination kinetics, or another phenomenon. Insulin concentrations remained elevated for more than 48 h before returning to normal ranges. These elevated insulin concentrations make individuals prone to hypoglycemia after the termination of HIE. Since this patient had fully recovered by the time the HIE was terminated, we are unable to comment about an effective insulin concentration. While it is unclear whether HIE should be down-titrated or terminated, clinicians need to be aware that patients remain at risk of hypoglycemia long after HIE is stopped. Further research is needed to determine how higher doses of insulin, with or without impaired kidney function, alter these findings.

KEYWORDS High dose insulin, HDI; high dose insulin euglycemic therapy, HIE; hypoglycemia

bwiener2@gmail.com

168. Laundry pod toxicity after a decade on the market: evaluating the impact of packaging and product changes

Sarah Berg[a], Sonya Rashid[a] and Michael Wahl[b]

[a]Toxikon Consortium, Chicago, IL, USA; [b]Illinois Poison Center, Chicago, IL, USA

Background: Liquid laundry pods were introduced to the US market in 2012. Soon after introduction, poison centers reported incidents of severe toxicity. Case reports in the medical literature described surprisingly severe morbidity, including depressed mental status, respiratory depression, severe dermal burns, and ocular injury. The severity of symptoms led to calls for changes in packaging, design, and composition of liquid detergent packages. In 2014, the American Society for Testing Materials (ASTM) developed standards recommending product changes to reduce exposure-related injury in young children. Previous studies have shown a decrease in healthcare utilization, even though unit sales have increased yearly. In this study, we identified specific changes in clinical effects, medical outcomes, and healthcare utilization from pediatric exposures from the first two full years after introduction of laundry pods (2013–2014, pre-intervention) and the last 2 years available in the National Poison Data System (NPDS) (2020–2021, post-intervention) after the adoption of ASTM standards.

Methods: We queried the NPDS for "laundry detergents: liquids" (AAPCC code 201182) for pediatric cases (0–5 years) from January 1, 2013 to December 31, 2014 and from January 1, 2020 to December 31, 2021. We analyzed for changes in patient demographics, route of exposure, symptoms, outcomes, and healthcare utilization for these time periods. Clinical effects were grouped by organ system. We used chi-square tests to analyze changes in medical outcomes and healthcare utilization. Cases followed to a known outcome were included.

Results: 21,865 cases from the 2013–2014 (pre-intervention) period and 20,912 cases from the 2020–2021 (post-intervention) period were found in NPDS. Most common routes of exposure were ingestion (78.4% pre-intervention, 65.9% post-intervention), ocular (11.9% pre-, 19.4% post-), or dermal (9.0% pre-, 14.1% post-). There was a decrease in gastrointestinal, respiratory, cardiovascular, and neurologic symptoms in post-intervention exposures compared to pre-intervention exposures. There was an increase in cases with no clinic effect and in cases with ocular and dermal symptoms in the post-intervention period. There was a decrease in the number of patients admitted to the hospital for both ICU and non-ICU care. The number of subjects who were treated and discharged increased in the post-intervention period. Fewer exposures resulted in major, moderate, and minor effects in the post-intervention period compared to the pre-intervention period. There was an increase in the number of exposures reported to have no clinical effect in the post-intervention period.

Conclusions: The incidence of respiratory, gastrointestinal, cardiovascular, and neurologic symptoms after laundry pod exposure decreased in the post-intervention years, despite a relatively similar number of cases reported to poison centers in the years studied. Exposures after the changes made to products and packaging were significantly less likely to lead to admission to healthcare facilities and significantly less likely to cause significant medical effects compared to exposures before the intervention. The changes appear to have made a positive impact on morbidity associated with childhood exposure to laundry pods.

KEYWORDS Laundry pods; pediatric ingestion; detergent

seberg2@gmail.com

169. Pediatric opioid toxicity secondary to buprenorphine: a review of cases reported to the ToxIC Registry 2010–2021

Meghan Spyres[a], Gregory Makar[a], Sharon Campleman[b], Shao Li[b], Paul Wax[c], Jeffrey Brent[d] and Kim Aldy[e]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]University of Arizona College of Medicine, Phoenix, AZ, USA; [b]American College of Medical Toxicology, Phoenix, AZ, USA; [c]University of Texas Southwestern, Paradise Valley, AZ, USA; [d]School of Medicine, University of Colorado, Denver, CO, USA; [e]American College of Medical Toxicology (ACMT), Phoenix, AZ, USA

Background: In adults, buprenorphine's opioid effect has a "ceiling" which limits toxicity in overdose. Conversely, significant

toxicity in the pediatric population has been reported but extent of clinical occurrence has thus far been poorly characterized. We hypothesize that buprenorphine exposures make up a significant portion of pediatric opioid exposures reported to the ToxIC Registry and that naloxone administration is common.

Methods: The ToxIC Core Registry is a multi-center database of patients cared for by medical toxicologists and includes 35 US and 5 international sites. The Registry was queried from April 15, 2010 to November 11, 2021 for all opioid exposure cases in ages <12 years old. Descriptive statistics were used to further characterize single agent buprenorphine exposures (SABE) across different age groups.

Results: Of the 640 pediatric (age <12) opioid exposure cases reported to Toxic Core Registry 35% (223) of cases involved buprenorphine. SABE represented 77% (172) of Buprenorphine exposures reported. Most cases of SABE were in those age 0–23 months ($n = 86$, 50%), followed by age 2–6 years old ($n = 82$, 48%) and age 7–12 years ($n = 4$, 2%). Girls made up 51% ($n = 88$). Dose was reported in 33 SABE cases; average dose was 6 mg (range 2–8 mg). The most common reason for encounter was unintentional ingestion ($n = 166$, 97%). The most common clinical symptoms were central nervous system depression ($n = 117$, 68%) and respiratory depression ($n = 48$, 28%). Toxicologic treatment was reported in 100 cases (58%). Naloxone was administered in 89 (52%) cases. No deaths were reported.

Conclusions: Pediatric buprenorphine exposures reported to the ToxIC Core Registry represented more than 1/3 of all reported pediatric opioid exposures; most commonly in younger children. SABE made up the majority of cases and naloxone administration was common. This information suggests that isolated buprenorphine exposure should be considered in pediatric patients presenting with opioid toxicity, and inclusion of buprenorphine screening tests in addition to standard urine drug screens could detect additional pediatric opioid exposures.

KEYWORDS Pediatric; overdose; buprenorphine

mspyres@gmail.com

170. Inadvertent ingestion of medical aid in dying medications

Christopher Pitotti[a], Spencer Laehn[b], Sean Morgan[b] and Kerri Mason[b]

[a]RMPDS, Denver, CO, USA; [b]Denver Health Medical Center, Denver, CO, USA

Background: Medical Aid in Dying (MAiD) is authorized in ten states and Washington, DC for adult patients with decisional capacity who desire to end their life due to a confirmed terminal medical condition. This self-administered practice typically occurs at home, using a combination of sedative-hypnotic, opioid, and cardiotoxic medications after antiemetic pretreatment. Prescribing physicians carefully screen candidates and counsel on medication safety. Despite thousands of administrations this appears to be the first published case report describing the clinical course and therapeutic challenges of an inadvertent ingestion of a human MAiD preparation.

Case report: A 37-year-old male was found comatose within minutes of ingesting one sip of his friend's MAiD regimen consisting of micronized digoxin 100 mg, diazepam 1 g, morphine 15 g, amitriptyline 8 g, and phenobarbital 5 g (DDMAPh) mixed in at least 4 oz of sports drink. Ethanol and cannabis use preceded the exposure. The patient was unresponsive to naloxone and endotracheally intubated without medication. Post-intubation blood pressure 134/90 mmHg and sinus rhythm 142 bpm. In the Emergency Department vital signs included blood pressure 129/53, heart rate 85, and temperature 35.7 °C. Electrocardiogram changes included PR prolongation, sodium bicarbonate-responsive QRS prolongation to a maximum 149 ms, RSR' morphology, and progressive ST-segment scooping. Laboratory results were remarkable for a serum potassium peak 3.6 mmol/L, lactate 4.7 mmol/L, pH 7.36 and pCO_2 41 mmHg, creatinine 1.52 mg/dL, ethanol 198 mg/dL, total digoxin >10 ng/mL and phenobarbital <5.0 mcg/mL within 1 h of ingestion. Interventions included nasogastric suctioning, multidose activated charcoal, seven boluses of sodium bicarbonate 8.4% 50 mL and three vials of digoxin-specific antibody fragment (DSFab). The remainder of the hospital's DSFab supply was readied at bedside. No dysrhythmias developed. Acute kidney injury and aspiration pneumonia were diagnosed. The patient was transferred to an extracorporeal life support capable (ECLS) facility for potential precipitous decline where he recovered without further antidote. Extubation and discharge with a normalized electrocardiogram occurred on hospital day 2 and 4, respectively.

Discussion: DDMAPh results in sedation within minutes and death within hours. Assuming normal pharmacokinetics, neutralizing digoxin 100 mg could require 160 vials of DSFab outstripping any hospital inventory. We chose an interval-, rhythm-, and instability-triggered sodium bicarbonate and DSFab dosing management plan. Only a few milliliters of the regimen would be necessary to cause CNS depression. Three phenobarbital concentrations below the limit of detection suggest a small, incompletely mixed, or differentially absorbed ingestion. This good outcome was likely due to early intubation and critical care given his aspiration, respiratory depression and need for multiple doses of sodium bicarbonate.

Conclusions: All healthcare providers should be familiar with the composition of medications used for MAiD and be prepared to manage situations in which these medications are ingested inadvertently. Any substantial ingestion or evidence of progressive toxicity, particularly from the field, should prompt consideration for transport to an ECLS facility.

KEYWORDS Medical aid in dying; digoxin; amitriptyline

cpitotti@aol.com

171. Locked up: freeing OGs from p-resins (polymerized-resins)

Thao-phuong Hallett[a] and Emily Kiernan[b]

[a]Georgia Poison Center, Atlanta, GA, USA; [b]Emory University SOM; Georgia Poison Center, Atlanta, GA, USA

Background: Epoxy resin products are broadly marketed and appeal to children and adults alike. Most epoxy resins are made from an epoxide and a hardener and have many common applications in leisure, work, and transportation settings. Popular consumer uses include adhesives, paints, and coatings in countertop, surfboard, jewelry, and craft fabrication and repair. When mixed in the correct proportions and cured over time, the parts react to form cross-linkages and polymerize into plastic resin. A 2-year-old female presented to the pediatric emergency department in respiratory distress after swallowing resin substrate. The patient was intubated and an orogastric tube (OGT) was placed. The plastic from the OGT reacted with resin substrate in the stomach. Single-use plastics are used frequently in health care activities and may interact with ingested resin or its substrates, making removal and management difficult. The primary objective was to observe the time-to-release of a single-use plastic OGT bound to polymerized resin using multiple consumption-safe solvents (CSS).

Methods: Six glass containers were used to hold the experiments. Each container had a 25 cm-10 Fr orogastric tube with a portion submerged in cured epoxy resin. The resin was formed with 10 mL of epoxy resin base and 10 mL of epoxy resin hardener and left to cure for 48 h. Each orogastric tube with cured resin container was placed with 60 mL of CSS. The CSS included normal saline, 5%

acetic acid, citrus-based degreaser, 40-proof whiskey, cola soda, and 70% isopropyl alcohol. No agitation occurred after the solvents were added. Each container was evaluated at 1-, 5-, 10-, 15- and 30-minute intervals and then 1-, 2-, 3-, 4-, 24- and 48-h intervals. After each interval, tension was applied to the orogastric tubing to determine if the tubing was freed.
Results: The 40-proof whiskey freed the orogastric tube after 15 min. The 5% acetic acid freed the orogastric tubing at 3 h. The other solvents did not extract the orogastric tubes by the 48-h interval.
Conclusions: Whiskey and acetic acid may be consumption-safe solvents used to remove single-use plastics, like an OGT, from polymerized resin. Interpret results with caution as this in vitro study may not be generalizable to in vivo use. Further testing is warranted to better understand management strategies and reduce plastic resin hardener ingestions and poisonings.

KEYWORDS Resins; plastics; pediatric

TCHALLE@emory.edu

172. Massive acetaminophen ingestion resulting in altered mental status and intubation without metabolic acidosis after early treatment with fomepizole and N-acetylcysteine

Christopher Dion[a] and Meghan Spyres[b]

[a]Banner University Medical Center – Phoenix, University of Arizona College of Medicine – Phoenix, Phoenix, AZ, USA; [b]University of Arizona College of Medicine, Phoenix, AZ, USA

Background: Acetaminophen (APAP) overdose is one of the most common overdoses in the US. Altered mental status in massive APAP overdoses is uncommon and is typically associated with anion gap metabolic acidosis. Although evidence supports the use of fomepizole (4-MP) in massive APAP overdose, optimal medical management remains unclear.
Case report: A 17-year-old female presented to the ED 2 h after reported ingestion of 100–150 500 mg APAP tablets (800–1200 mg/kg), a caffeinated energy drink and an unknown number of sennoside tablets. The patient was treated with 21-h N-acetylcysteine (NAC) (300 mg/kg) protocol and 4-MP (15 mg/kg) within 3 h of ingestion. Labs drawn before medication administration were remarkable for pH 7.39, lactic acid 2.9 mEq/L, APAP level 73.6 μg/mL, and no anion gap. APAP level 5 h after ingestion was 190.2 μg/mL. The patient developed abdominal pain followed by an episode of altered mental status and multiple episodes of apnea lasting up to one minute; she was then intubated. CT brain without contrast was unremarkable. Serial APAP levels were obtained (using ingestion as time 0): 12 h level-391.8 μg/mL, 24 h level-291 μg/mL, 44 h level-42.4 μg/mL, 60 h level-2.8 μg/mL. She did not have any significant increase in her AST, ALT or PT. Lactic acid level decreased and remained within normal limits after initial elevation. Metabolic acidosis was never present. Repeat dose of 4-MP (15 mg/kg) and continued NAC course (300 mg/kg over 48 h) were given due to her elevated APAP level. She was successfully extubated on day 2. She had significant abdominal pain after extubation that resolved by day 3. She was medically cleared for discharge on day 4. GC/MS of the urine was positive for nicotine, cotinine, APAP, caffeine, theobromine. Urine immunoassay testing for drugs of abuse was negative. Patient confirmed her ingestion to be isolated to APAP and sennoside.
Discussion: This case is unique as altered mental status from massive APAP ingestion without metabolic acidosis has not previously been reported. Drug testing and patient interview did not give any evidence for other causes of respiratory depression or apnea. Her peak APAP concentration of 391.8 μg/mL measured 12 h after ingestion demonstrated that she had a high body burden on presentation. Her 5 h APAP levels of 190.2 μg/mL was lower than expected given her symptoms. The patient was chronically taking sennoside laxatives. She had an undiagnosed eating disorder, that included binging and purging behaviors, which may have changed absorption kinetics. One possible mechanism for her lack of acidosis could be the protective effect that 4-MP has on mitochondria, as this patient received 4-MP at a much earlier time than previous cases. Finally, the late peak of her APAP level demonstrates the importance of repeat APAP levels in massive ingestion.
Conclusions: We present a case of a massive APAP overdose treated early with 4-MP and standard NAC dosing who developed CNS depression without metabolic acidosis at lower than expected serum APAP concentrations. Further investigation into the role of early 4-MP in the prevention of the development of metabolic acidosis and the pathophysiology of coma in massive APAP ingestion is needed.

KEYWORDS Massive acetaminophen overdose; fomepizole; coma

christopher.dion@bannerhealth.com

173. Impacts of social distancing on patients with suicide attempt who visited the emergency department during COVID-19 pandemic

Jisook Lee[a] and Woochan Jeon[b]

[a]Department of Emergency Medicine, Ajou University School of Medicine, Suwon, South Korea; [b]Department of Emergency Medicine, Inje University Ilsan Paik Hospital, Ilsan, South Korea

Background: After coronavirus disease 2019 (COVID-19) pandemic, social distancing (SD) was the main strategy of controlling COVID-19 by government in South Korea. Suicide and psychiatric disorders were reported as one of the vulnerable factors to infectious disease and social connection. The purpose of this study is to find the characteristics of patients with suicide attempts and the effect of SD intensity during COVID-19 pandemic in South Korea.
Methods: This was a retrospective observational study in single regional emergency center in Gyeonggi-do with an annual visit of 87,000 patients. We compared the characteristics of patients with suicide attempts during March 2020 to February 2021 (COVID era) with those during March 2019 to February 2020 (pre-COVID era). Proportion of patients with suicide attempt were compared in each era. The correlation of proportion of patients with suicide attempt and number of COVID-19 confirmed cases were analyzed. The monthly trends and differences were compared. We also compared the characteristics according to the level of SD. As the intensity of SD overall period, we divided SD to low-intensity and high-intensity. Eased SD, stage 1 and 1.5 were referred as low-intensity SD. Enhanced SD, stage 2 and 2.5 were referred as high-intensity SD.
Results: Proportion of patients with suicide attempt during COVID era was significantly increased to 1.9% compared to that during pre-COVID era, 1.0% ($p = 0.000$). Proportion of patients with suicide attempt in Seoul and Gyeonggi-do area and the confirmed cases of COVID-19 were correlated ($r = 0.076$, $p = 0.003$). During COVID era, median age was younger (36.0 vs. 31.0 yrs, $p = 0.005$) and female patients were increased (60.4 vs. 66.8%, $p = 0.004$). Proportion of laceration as method of suicide attempt was increased (19.7% to 26.7%). Primary risk factors for suicide attempt as relationship (11.8% vs. 21.3%, $p = 0.000$), disease or death (1.5% vs. 4.6%, $p = 0.000$) and financial problems (1.5% vs. 3.2%, $p = 0.021$) significantly increased

during COVID era while risk factor as psychiatric disease was decreased (83.4% vs. 70.5%, $p = 0.000$). Proportion of patients with psychiatric disorder had tendency to decrease and increase after July. During low-intensity SD, age, sex, previous suicide attempt and psychiatric disorder as risk factor shown no differences. During high-intensity SD, previous suicide attempt, risk factors (relationship, disease and death, financial problems) were increased.
Conclusions: After COVID-19 pandemic, proportion of patients with suicide attempt were increased. With prolonged pandemic period and high-intensity SD, female and younger patients and patients with previous suicide attempt were increased. Primary risk factors as relationships, disease or death and financial problems were increased. The governmental regulations and community's supports could be modified with these results.

KEYWORDS COVID-19; social distance; suicide

eesysook@naver.com

174. Knowledge and perceptions of health literacy among clinical poison control center staff

Emily Paterson[a], Jennifer Eskridge[b], Kelly Teemant[c], Laura Morehouse[d] and Fiorella Carhuaz[e]

[a]Maryland Poison Center, Baltimore, MD, USA; [b]Oregon Poison Center at OHSU, Portland, OR, USA; [c]Utah Poison Control Center, Salt Lake City, UT, USA; [d]Arizona Poison and Drug Information Center, Tucson, AZ, USA; [e]Virginia Poison Center, Richmond, VA, USA

Background: Approximately 36% of adults in the US have limited health literacy which impacts their ability to obtain, process, and understand basic health information needed to make appropriate health decisions. Limited health literacy can adversely affect the quality of their health care as well as health outcomes. Health literacy is a key factor in communication between patients and health care professionals. However, there is limited research on the importance and understanding of health literacy in US poison centers. This pilot study examined the knowledge, perceptions, and use of health literacy techniques among clinical US Poison Control Center (PCC) staff.
Methods: A self-administered, pilot survey using a web-based survey tool was sent to five US PCCs. PCC clinical staff were recruited to participate by the authors of the pilot survey. The survey consisted of 15 questions: six demographic, two health literacy knowledge, five health literacy perception, and two conclusions. Responses were anonymously recorded.
Results: 63 PCC staff responded to the survey. 63.77% were Specialists in Poison Information, and the remaining respondents included: clinical toxicology fellows, poison information providers, medical directors, managing directors, and toxicologists. The majority of respondents (31.75%) indicated that they worked 10 years or more at a PCC. Prior to taking the survey 95% of respondents have heard of health literacy and 95% believe that health literacy is very or extremely important to their role at the PCC. Health literacy techniques indicated being used most of the time or always as follows: repeating information (96.73%), speaking slowly and clearly (91.80%), asking whether the information is understood of if there are any questions (83.60%), and using plain, non-medical language (62.30%). Health literacy techniques used the least (sometimes or never) include limiting the amount of information by providing 2–3 concepts at a time (11.48%), and using the "teach-back" method (57.37%). Common barriers preventing effective communication with callers included: complexity of information (20%), lack of time (17%), and insufficient cognitive skills (16%).
Conclusions: Almost all of the respondents were familiar with the concept of health literacy and did feel that it was an important part of their role at the PCC. However, health literacy techniques are not always used when PCC staff are providing information to the public. Further data collection is needed to better understand barriers to utilizing effective health literacy techniques as well as resources that can support clinical staff in doing so.

KEYWORDS Health literacy; health communications; communication barriers

epaterson@rx.umaryland.edu

175. The histamine intolerance case series in Thai entomophagy culture

Pattaraporn Mekavuthikul[a], Summon Chomchai[a], Pongthorn Jantataeme[b] and Jariya Phuditshinnapatra[a]

[a]Faculty of Medicine Siriraj Hospital, Bangkok, Thailand; [b]Maharaj Nakhon Si Thammarat Hospital, Nakhon Si Thammarat, Thailand

Background: Entomophagy is the newest dietary trend since insects are nutritious, easy to raise, and eco-friendly. However, the consumption of insects has related to health hazards. One of them is histamine poisoning or scombroid toxicity. Histamine is generated when histidine, a protein found in insect flesh, decomposes. Histamine toxicity can cause flushing, pruritus, wheezing, nausea, vomiting, or life-threatening anaphylaxis. We presented 14 cases of entomophagy-related putative histamine intolerance.
Case series: : We conducted prospective case series with standard collection protocol in Maharaj Nakorn Si Thammarat hospital. We reported 14 cases of histamine intolerance, which were divided into 9 possible cases and 5 probable cases. The development of histamine intolerance symptoms following a cluster of insects has been defined as a probable instance. A possible case was defined as someone who acquired allergic symptoms after consuming an insect with no previous history of insect allergy. Symptoms appeared 15–420 min after intake (median 30 min). Causative insects were identified as sago palm larva (five cases), alate termite (three cases), Asian weaver ant's eggs (three cases), cricket (one case), silkworm (one case), and grasshopper (one case). Flushing, pruritus, and urticaria were the most prevalent symptoms, appearing in 13 cases. Chest tightness was described in five instances, and bronchospasm was reported in one case. Three cases of low blood pressure were observed. In eight cases, GI adverse effects such as nausea, vomiting, and diarrhea were discovered. In patients who were not met the anaphylaxis criteria were five cases. Onset time was ranging from 10–420 min (median 15 min). Nine people met the anaphylactic criteria in our study, with onset times ranging from 15 to 120 min (median 45 min). All of the anaphylaxis cases were treated with adrenaline injections, intravenous antihistamines, intravenous steroids, and hospitalization.
Discussion: We reported 14 case series of entomophagy-related histamine intolerance involving diverse types of insects. The quick onset (30 min) was observed in our study which was comparable to the previous report of entomophagy-related histamine poisoning. Life-threatening complications such as anaphylaxis were often diagnosed after insect consumption which leaded patients to a hospital. Patients that met anaphylactic criteria had a longer onset than non-anaphylaxis patients, and the therapy was similar to that of allergic anaphylaxis. The median time required for anaphylaxis-like patients to develop symptoms was 45 min, longer than in non-anaphylaxis patients (30 min), indicating that histamine absorption took longer. A decrease in diamine oxidase, the enzyme that breaks down histamine in the GI tract

and prevents it from being absorbed, might be related to allergies or current pharmaceutical use. Histamine intolerance can occur in patients with low diamine oxidase levels. However, in our population, there was no case with a history of allergy or current medication.
Conclusions: Histamine intolerance from entomophagy can induce allergic symptoms such as flushing, chest tightness, bronchospasm, and anaphylaxis. The onset was rapid, and the therapy was the same as for allergies caused by other factors. There was no history of allergy or pharmaceutical usage in our series.

KEYWORDS Histamine poisoning; entomophagy downside; insect induced hiatamine intolerance

pattaraporn.mek@mahidol.ac.th

176. BaFLofen: a case of nootropics gone awry leading to 4-fluorophenibut toxicity

Alek Adkins[a], Erin Gramm[b], Joshua Shulman[a] and Anthony Pizon[a]

[a]University of Pittsburgh Medical Center, Pittsburgh, PA, USA; [b]University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Background: Nootropics, drugs that enhance memory and cognitive function, have been of interest since the 1970s when they were studied in the treatment of dementia, schizophrenia, and stroke. Newer nootropics that have come up on social media include 4-fluorophenibut (4-FP) and fladrafinil. 4-FP has been marketed as an anxiolytic sleep aid that is five to ten times more potent than phenibut. Fladrafinil, an analog of adrafinil, is marketed as a eugeroic agent similar to modafinil. There is scarce data on 4-FP and fladrafinil with no known prior reported cases of toxicity. The aim of this case report is to describe a case of acute intoxication 4-FP and fladrafinil.
Case report: A 34-year-old male with a history of attention deficit hyperactivity disorder presented to an outside hospital (OSH) with altered mental status. His wife reported that he consumed an unknown amount of two new supplements, 4-FP and fladrafinil. Six hours after falling asleep, his wife found him slumped over in the bathroom with muscle twitching. In the emergency department, he had waxing and waning episodes of agitation and stupor, seizure-like activity, and was intubated for airway protection. At the tertiary care center, he was sedated on propofol and midazolam infusions for 48 h with episodes of breakthrough agitation. Continuous EEG showed evidence of severe diffuse encephalopathy without seizure activity. 72 h after presentation, sedation was weaned and he was extubated, and his mental status returned to baseline 120 h after admission. Patient confirmed that he used "4 scoops" of 4-FP and 1–2 drops of fladrafinil prior to presentation, and that these were new supplements he recently bought online. His hospital course was complicated by aspiration pneumonia which was treated with antibiotics.
Discussion: 4-FP dosing is inconsistent, with marketed doses ranging from 50 to 600 mg, which can easily lead to an accidental overdose. Rat models have shown 4-FP is a GABA-B agonist with a stronger affinity to GABA-B than phenibut but lower than baclofen. Similar to phenibut intoxication, this can present with fluctuations in mental status from agitation to stupor, seizure activity, and autonomic instability. This patient's presentation with waxing and waning episodes of stupor and agitation with seizure-like activity is more consistent with GABA-B intoxication than fladrafinil toxicity, which we would expect to present as a stimulant/sympathomimetic toxicity.
Conclusions: There is limited research on 4-FP, but medical toxicologists should recognize this xenobiotic is readily available via the internet and may present as a more potent GABA-B receptor agonist than phenibut. This increased potency may increase toxicity associated with 4-FP use. As seen in this case, 4-FP toxicity led to seizure-activity and altered mental status. As 4-FP dosing is not clearly established and use is not well regulated, there are risks of adverse effects from toxicity and further research is needed.

KEYWORDS 4-Fluorophenibut; GABA B toxicity; nootropics

adkinsaq@upmc.edu

177. Successful organ transplantations after brodifacoum poisoning

Alexandra Funk[a], Stefan Weekes[a], Nikki Coble[b], Trish Carroll[c] and Justin Arnold[a]

[a]Florida Poison Information Center – Tampa, Tampa, FL, USA; [b]Florida Department of Health, Tallahassee, FL, USA; [c]LifeLink of Florida, Tampa, FL, USA

Background: Organ transplantation literature after brodifacoum poisoning is scarce. In a recent outbreak of coagulopathy and brodifacoum poisoning after synthetic cannabinoid use, 54 cases were identified with 6 (11%) fatalities. We describe two cases of successful solid organ transplantation after brodifacoum poisoning.
Case series: The first donor, 41-year-old male, presented to emergency department unresponsive with hematemesis and in cardiac arrest, later with ROSC obtained, suspected from hemorrhagic shock. Past medical history (PMH) was unknown. Initial labs hemoglobin (Hgb) 2.5 g/dL, hematocrit (Hct) 7.5%, PT >90 seconds (s), PTT 139 s, INR above detection level, and platelets 126 10○3/μL. Treatments included 4 units packed red blood cells, 4 units fresh frozen plasma, 2196 units four-factor prothrombin complex concentrate (human), vitamin K 10 mg IV ×1 followed by 50 mg OG TID, epinephrine, sodium bicarbonate, and pantoprazole. Repeat labs improved after initial therapy Hgb 9.3g/dL, Hct 32.7%, PT 12.1 s, INR 1.1. and throughout hospitalization. Brodifacoum level drawn on hospital day 1 was 270 ng/mL. On hospital day 2 patient was declared brain dead and decision for heart organ procurement was determined. The recipient, unknown age/gender/PMH, tolerated transplantation well with no abnormalities seen on cardiac biopsy and lab assessments, including no evidence of coagulopathy or hemorrhage noted post-transplant. Hgb, Hct, PT/INR were reported to be within normal limits; specific lab values were not available. No additional therapy beyond standard post-transplant care including vitamin K was required. The second donor was a case identified by the organ procurement team after the death. Demographics, presentation, labs, and treatments provided were not available. Three organs, heart, liver, and kidney were successfully harvested and transplanted to three recipients. The patients receiving the liver and kidney had no evidence of coagulopathy, hemorrhage, or required additional therapy beyond standard post-transplant care. Information on the third recipient of the heart was not available.
Discussion: Of the 54 cases involved in the outbreak, six cases (11%) were fatalities, with two cases that underwent organ transplantation. The two donors had four organs successfully harvested and transplanted including two hearts, one kidney and one liver. Unfortunately, there are limitations to the details of the cases. The second donor did not have laboratory confirmed quantitative brodifacoum testing completed. However, was still considered a probable case based on our definition for this

outbreak, and death suspected from brodifacoum poisoning. Further information post transplantation for all recipients is limited due to constraints of anonymity and knowledge sharing practices. Lastly, through discussions with the organ procurement team, they were unaware of the resources poison centers/toxicologists offer to aide transplantation patient care coordination secondary to poisoning deaths.
Conclusions: Transplantation after brodifacoum poisoning can be successful. Transplant and organ procurement teams should collaborate with toxicologists when death is secondary to poisoning, as toxicologists can provide specific monitoring and antidote recommendations, enhance awareness of resources and knowledge sharing practices, and continue to support evidence-based medicine.

KEYWORDS Transplant; brodifacoum; coagulopathy

afunk@tgh.org

178. Lysergic acid N-methyl-N-propylamide and dextromethorphan co-ingestion associated with acute multi-organ failure

Michael Simpson[a], Christopher Watson[b], James Whitledge[b] and Michele Burns[c]

[a]Boston Children's Hospital, Brookline, MA, USA; [b]Boston Children's Hospital, Boston, MA, USA; [c]Boston Children's Hospital/Harvard Med Toxicology, Belmont, MA, USA

Background: Lysergic acid N-methyl-N-propylamide (LAMPA) is an isomer of lysergic acid diethylamide (LSD) used to circumvent the Schedule I status of LSD. Data on the clinical effects of LAMPA exposure are lacking, but neither LAMPA nor LSD, nor dextromethorphan are known to cause multi-organ failure in the absence of severe hyperthermia.
Case report: A 17-year-old male used five tabs of presumed LSD blotter paper purchased from social media, as well as an unknown amount of dextromethorphan, recreationally. Three hours later, he developed seizures, delirium and agitation requiring intubation, and a peak core temperature of 100.7 Fahrenheit. A friend who used only the supposed LSD tabs did not require medical care. The patient was admitted to the intensive care unit and by hospital day (HD) three had developed rhabdomyolysis, disseminated intravascular coagulation, and acute renal and hepatic failure. He received N-acetylcysteine, vitamin K, plasma transfusions, and a dextrose infusion for recurrent hypoglycemia. He was listed for liver transplant. The patient had a history of recreational mushroom ingestion, and cyclopeptide toxicity was considered as a possible etiology of his acute liver failure. He underwent one session of plasmapheresis for theoretical extracorporeal toxin removal. He underwent hemodialysis starting on HD four, again for possible toxin removal, in the setting of acute renal failure. International normalized ratio (INR) peaked at 7.3 on HD three and normalized on HD 11. Hemodialysis continued until HD 34. His course was complicated by cerebral edema, post-extubation hypoxic respiratory failure requiring non-invasive positive pressure ventilation, and posterior reversible encephalopathy syndrome. He regained innate hepatic and renal function and was discharged home neurologically intact on HD 47. Due to the discordance between presentation and reported ingestions, serum samples collected approximately 2 h after reported exposure were sent for public health novel psychoactive substance testing via the US Drug Enforcement Agency Toxicology Testing Program (DEA TOX). This testing resulted 45 days after exposure, and revealed serum LAMPA concentration of 6.4 ng/mL (fatalities reported with serum LSD concentrations of approximately 14 ng/mL) and serum dextromethorphan concentration of 847 ng/mL (serotonin syndrome reported with serum dextromethorphan concentration 950 ng/mL).
Discussion: The case presented here adds to the scant literature regarding toxicities of LSD isomers and how they might differ from LSD. LSD and dextromethorphan have been implicated in serotonin syndrome and death in massive exposures, but previous cases of critical illness have involved severe hyperthermia, which is suspected to be the mechanism of end organ failure. The relationship between LAMPA concentration and clinical effects is not well established, but LAMPA is thought to be 40% as potent as LSD at the 5-hydroxytriptamine-2A receptor. Thus, the degree of end organ toxicity seen in this case is much more severe than what would be expected with these serum concentrations of LAMPA and dextromethorphan, and occurred in the absence of severe hyperthermia. These compounds may have as of yet undescribed synergistic toxic effects.
Conclusions: LAMPA and dextromethorphan co-ingestion was associated with acute multi-organ failure in this previously healthy adolescent despite the absence of significant hyperthermia.

KEYWORDS LAMPA; dextromethorphan; LSD

Michael.simpson@childrens.harvard.edu

179. Research first AIDE – using artificial intelligence to optimize clinical toxicology data abstraction

Varun Vohra[a], Adam Frisch[b], Tony Wang[b], Kevin Zhang[b] and Andrew King[a]

[a]Michigan Poison and Drug Information Center at Wayne State University School of Medicine, Detroit, MI, USA; [b]Institute for Data Driven Public Policies, Pittsburgh, PA, USA

Background: Poison center data is often used and integrated into patient care guidelines. These patient care functions are inextricably tied to required medical record documentation and ongoing provision and maintenance of accurate clinical data. Analysis of case data and trends inform clinicians on patient management during toxicologic emergencies. However, poison center data come with limitations. For each case, clinical data are recorded in the patient narrative in a free-text format in addition to standardized codes for signs, symptoms, and treatments derived from the National Poison Data System. Discrepancies between the patient narrative/clinical course and standardized codes is a common phenomenon; this skews reported exposure frequencies, affects case epidemiology, and distorts the accuracy of data used to guide treatment decisions. Our objective was to evaluate adverse effects secondary to flumazenil administration over time using artificial intelligence data extraction (AIDE) that analyzes unstructured clinical toxicology data to optimize data abstraction and inform more robust patient care.
Methods: The AIDE process was applied to a retrospective chart review of our poison center cases evaluating the frequency of adverse effects from flumazenil between January 1, 2012 and December 31, 2019. Inclusion criteria were flumazenil administration, age, sex, adverse effects, mental status changes, history of chronic benzodiazepine use or seizure disorder, exposure to proconvulsants, and co-administration of naloxone. Exclusion criteria were patients who did not receive flumazenil. A total of 585 cases were included for final analysis by AIDE, which extracts data from clinical notes accurately and efficiently using a weakly supervised deep neural network via an interactive two-stage process: Stage 1, at the word level and Stage 2, at the sentence or paragraph level. The researcher starts with a specific search term such as "flumazenil." The system then determines variations of this word in the data set (abbreviations, misspellings, synonyms, etc.) and requests the researcher confirm these variations. The

AIDE system can then accept other terms, such as side effects, and once again confirm variations. Once the variations of terms are identified, the AIDE system uses sentence embedding and heuristic reasoning to determine accurate representations of the unstructured data. Data combinations can be tied to specific outcomes and the outputs can be tailored to the researcher's needs.
Results: Based on preliminary results, of the 585 original cases, 262 had a subjective assessment that mentioned at least one drug or substance used in a non-pharmacologic way. Of these, 112 (43.7%) mentioned only a single drug/substance. Within the total 262 assessments, a total of 505 drugs/substances were mentioned. The AIDE was able to accurately identify 457 (90.5%) of these drugs/substances. Of the 262 total cases, the AIDE system was able to identify at least one drug/substance in 252 (96.2%) of the cases. The final study results with comprehensive analysis are pending completion.
Conclusions: This study intends to bolster the validity of poison center data by testing the fidelity between patient care narratives and required standardized coding. Based on preliminary results, this will help to ensure a more robust concordance of data components and more rigorous methodology for research purposes.

KEYWORDS Artificial intelligence; flumazenil; poison center

varun.vohra@wayne.edu

180. The UK National Poisons Information Service early warning system major incident example: Olympic Park, London, March 2022

Gill Jackson[a], Michael Eddleston[a], Sally Bradberry[b], Laurence A. Gray[c], Ruben H. K. Thanacoody[d] and Euan A. Sandilands[a]

[a]UK National Poisons Information Service, Edinburgh, UK; [b]National Poisons Information Service, Birmingham, UK; [c]National Poisons Information Service (Cardiff Unit), Cardiff, UK; [d]National Poisons Information Service (Newcastle Unit), Newcastle, UK

Background: Since 2012 the UK National Poisons Information Service (UK NPIS) has implemented a major incident early warning system (EWS) that operates spatially and temporally across the whole of the UK. The aims of the UK NPIS EWS are to alert, in real time, UK Government organisations (e.g., Centre for Radiation, Chemical and Environmental Hazards (CRCE)) and to support response teams and emergency responders manage casualties. Activity relating to over 150 chemicals of special interest are monitored 24/7 by the UK NPIS in real time via www.TOXBASE.org (poisons information database produced and maintained by the UK NPIS and used by all UK healthcare professionals) and via enquiries received on the UK NPIS helpline (0344 892 0111). To assess effectiveness UK NPIS EWS data were reviewed following a release of chlorine gas at London's Olympic Park swimming pool on the 23rd March 2022.
Methods: TOXBASE alerts (automatically generated, in real time, when a User accesses an entry of special interest) and telephone enquiries with respect to chlorine activity in March 2022 were reviewed.
Results: 359 TOXBASE alerts and 38 telephone enquiries were received relating to chlorine in March 2022; on average 12 alerts and 1 telephone enquiry a day. On the 23rd of March: 114 TOXBASE alerts were received; 91 online and 23 via TOXBASE App. Online alerts were generated in 28 different locations, primarily hospitals in London (61; 67%), other locations (30; 33%) included the London Ambulance Service and telephone triage services, known in the UK as NHS111. NB: Location for App Users not certain. 11 telephone enquiries were received from 9 different locations, primarily hospitals in London (7; 64%), other locations (4; 36%) included London based ambulance and NHS111 services. Timeline: 9:45 – chlorine gas release at Olympic Park swimming pool. 10:35 – first TOXBASE alert for chlorine received from London based hospital. 10:45 – first telephone enquiry received on the CRCE Chemical Hotline number; UK NPIS notified CRCE that an incident was taking place. 11:18; 12:27; 13.32 – UK NPIS updated CRCE that the incident involved hydrochloric acid (poured into the swimming pool resulting in the release of chlorine gas). Provided prospective management advice to multiple Emergency Departments (ED) in London that were anticipating large numbers of patients. 11:26; 12:18 – UK NPIS advised emergency responders triaging over 90 casualties on scene. 12:45; 13:46; 14:44; 16:27 – advised NHS111 and ED clinicians on treatment for symptomatic patients 13:35; 13:51 – TOXBASE alert and telephone enquiry from school in Derby, following accidental release of chlorine in a classroom; over 40 students affected. NPIS consultant toxicologist remotely triaged casualties on scene.
Conclusions: The UK NPIS has an established and proven early warning system to notify UK Government organisations of major incidents occurring. Within 1 h of the Olympic Park incident occurring the UK NPIS was able to identify incident location, the chemical involved, mode of release and provide updates as they occurred in real time. The advice provided by the UK NPIS ensured optimal patient care and prevented the unnecessary overuse of valuable ED resources. When future incidents occur in the UK it will be important for the UK NPIS to develop early incident specific strategies to ensure the best possible patient care alongside efficient use of resources.

KEYWORDS Major incident; emergency response; NPIS

Gill.Jackson@NHSLothian.scot.nhs.uk

181. Language Line® utilization at neighboring US poison control centers

Jennifer Eskridge[a] and Jared O'Connor[b]

[a]Oregon Poison Center at OHSU, Portland, OR, USA; [b]Washington Poison Center, Seattle, WA, USA

Background: Language barriers pose a significant challenge for poison control centers (PCCs) attempting to provide quality services to their callers and can delay prompt treatment in the case of medical emergencies. Professional interpreter services are strongly linked to improved medical outcomes with fewer medical errors and greater patient satisfaction. PCCs throughout the US currently utilize Language Line® Over-the-phone Interpretation Service to communicate with non-English speaking callers. Analysis of Language Line® data from two neighboring US PCCs with similar demographic and linguistic profiles provides insights into who is using the Language Line® to obtain PCC services.
Methods: Analysis of Language Line® usage and billing summary data from US Health Resources and Services Administration (HRSA) and raw query data from ToxiCALL,® the Electronic Medical Records database utilized by these PCCs, for a 12-month period from February 2021 to January 2022. To determine the number of potentially missed calls from Low English Proficient (LEP) Spanish-speaking callers, US Census Bureau data for the LEP Spanish-speaking population was divided by the population per call.
Results: Raw data obtained from ToxiCALL® indicated a combined total of 110,217 calls for the two PCCs during the 12-month review period. "Use of an Interpreter" information calls came from seven counties and "Use of an interpreter" human

exposure calls came from 26 counties (1 unknown). Data provided by HRSA® for both PCCs indicated 275 calls utilized the Language Line® service during the review period. Calls by month ranged from 10 (November) to 36 (April). 250 calls, or 90.1%, were conducted in Spanish. Mandarin: 6; Russian: 6; Vietnamese: 4; Mongolian: 2; Tagalog: 2; Chuukese: 1; Japanese: 1; Punjabi: 1; Somali: 1; and, Thai: 1; made up the remaining calls. We estimate that 93%, or 3397 of expected calls to the PCCs from the LEP Spanish-speaking population may be missing.

Conclusions: Spanish-speaking callers appear to utilize the Language Line® more frequently than any other documented language within the PCC service areas. This is consistent with US Census Bureau demographic and language data indicating people of Spanish descent and Spanish speakers are the largest non-White, non-English speaking population within the PCC service areas. The number of expected calls that were missed among the LEP Spanish-speaking population indicates the need to raise awareness about PCC services among this priority population. ToxiCALL® data may be helpful in determining where non-English speaking calls are occurring within PCC service areas as well as where to prioritize outreach, but it does not accurately reflect case data as documentation of "Use of an Interpreter" is not a mandatory field. Better understanding of the barriers to PCC and Language Line® utilization may be helpful in promoting the service among non-English speaking populations.

KEYWORDS Language; interpreter; Spanish

eskridge@ohsu.edu

182. Intentional oxalic acid ingestion results in significant esophageal injury and acute tubular necrosis

Forrest Mahony[a], Dayne Laskey[b] and Matthew Griswold[a]

[a]Hartford Hospital, Uconn School of Medicine, Hartford, CT, USA; [b]Hartford Hospital, University of Saint Joseph, Hartford, CT, USA

Background: Oxalates are cleaning products that are corrosive and irritating on contact. They can cause pneumonitis after aspiration and esophageal injury after ingestion. "Bar Keepers Friend" cleanser is a powdered oxalic acid-containing household cleaner that can lead to significant injuries when ingested or inhaled.

Case report: A 31-year-old male with a past medical history of bipolar disorder and previous suicide attempts presented to the Emergency Department (ED) after an intentional ingestion of an unknown quantity of a powdered cleansing product. After the ingestion, the patient became agitated, attacked prehospital providers, and required sedation with 300mg intramuscular (IM) ketamine. Upon arrival to the ED he required supplemental oxygen and deep suctioning to treat hypoxia. He also had a brief and self-resolving tonic-clonic seizure. Initial physical exam was pertinent for oropharyngeal erythema, horizontal nystagmus, brisk reflexes without hypertonicity or myoclonus. Initial laboratory data were significant for creatinine of 1.6 mg/dL, anion gap of 32, bicarbonate of 7 mmol/dL, arterial blood pH of 7.33, serum osmoles of 311 mOsm/kg, creatine kinase of 2091 U/L, and lactic acid of 2.7 mmol/L. On ICU day 2 the patient was started on dialysis. Esophagogastroduodenoscopy (EGD) demonstrated Grade 2b caustic esophagitis. On the day of arrival the patient developed progressive hypocalcemia as low as 7.5 mg/dL requiring calcium repletion, coinciding with the presence of dumbbell-shaped calcium oxalate crystals in urine microscopy. His hospital stay was further complicated by respiratory failure secondary to aspiration pneumonia requiring mechanical ventilation for 2 days. The patient's renal failure peaked with creatinine of 5.3 mg/dL and has since improved to 3.4 mg/dL at the time of submission.

Discussion: Ingestion of small quantities of oxalic acid cleaning substances is generally considered minimally harmful per MSDS sheets. However, larger ingestions may cause multi-organ damage and caustic injury. Unlike many calcium oxalate-containing plants which primarily cause topical mucosal irritation, oxalic acid also causes systemic injury including anion gap metabolic acidosis and acute tubular necrosis as calcium oxalate crystals precipitate into the urine. This is similar to the injury mechanism of ethylene glycol however without the precursor compounds, therefore, administration of fomepizole is not indicated. We propose that the significance of this patient's esophageal caustic injury was related to the large quantity of ingested oxalic acid-containing cleaning product. Furthermore, the patient's elevated anion gap, unremarkable osmolar gap, progressive hypocalcemia, and the presence of calcium oxalate crystals are consistent with the mechanism of calcium oxalate-induced renal injury.

Conclusions: Despite unremarkable warnings in material safety data resources, calcium oxalate-containing products can cause severe injury and pose potential for end-organ damage. Initial evaluation should include prompt EGD, laboratory evaluation, and consideration for hemodialysis. Facilities that do not have these specialties should discuss with their local Poison Control Center and consider transfer to a location with specialty services.

KEYWORDS Oxalic acid; renal; caustic

mahony@uchc.edu

183. Impact of poison center recommendations on medical outcomes in human exposure cases

Tara Boda, Kathy Suvak and Amanda Korenoski

Pittsburgh Poison Center, Pittsburgh, PA, USA

Background: Health care providers often contact poison control centers for treatment recommendations for acutely ill patients. In 2020, 253,033 human exposure cases requiring admission to a health care facility (HCF) were reported to US poison centers. Poison centers (PC) provide recommendations, but sometimes these recommendations are not followed or have already been performed in some way. Timely, regular and effective communication with clinical toxicology experts can potentially increase compliance and improve patient outcomes. The aim of this study was to describe PC consultation and recommendation compliance by medical outcomes in adult human exposures admitted to a health care facility.

Methods: The National Poison Data System (NPDS) was queried for adult human exposure cases managed by the Pittsburgh Poison Center in 2021 that required treatment by an HCF, including critical, non-critical, and psychiatric admissions. Cases were excluded if the patient was less than 20 years of age or no therapies were documented. Patients were also excluded if the case was not followed, the patient was treated and released, or only experienced unrelated effects. Data were separated into two groups: (1) with at least one therapy documented as PC recommended and performed and (2) no performed therapies listed as PC recommended and performed. Descriptive and Chi-squared statistical tests ($p < 0.05$ considered statistically significant) were used to analyze results.

Results: A total of 1815 cases were included. Patients were most likely already in a health care facility at the time of call (94.4%) and female (57%). Of total cases, 803 (44.2%) individuals were between the ages of 20–39 years, 673 (37.1%) between 40 and 59 years, 336 (18.5%) were 60+ years, and 3 (0.2%) were unknown-aged adults. There were 799 (44%) cases in which at least one PC recommendation was provided and performed,

while 1016 (56.0%) cases did not include a PC recommendation that was performed. A statistically significant difference in medical outcome was observed between the two groups ($p = 0.043$). There was a decrease in cases resulting in each medical outcome category when recommendations were performed: death (−7), major (−93), moderate (−87), minor (−27), and no effect (−3). The most common therapies recommended and performed by the PC were: IV fluids (314), benzodiazepines (211), IV NAC (168), and magnesium (126). The most reported interventions performed without PC recommendation were IV fluids (198), oxygen (197), ventilation (118), and intubation (116).
Conclusions: When poison centers' recommendations are accepted in adult patients, there were less instances of each defined medical outcome, with the largest difference in major and moderate outcomes. The poison center was most often contacted when the patient was already at an HCF, likely receiving some medical intervention. Health care providers most often performed lifesaving, emergent interventions (i.e., stabilizing airway or providing fluids) without PC recommendation. Poison center interventions provided and accepted were often medications or fluids. However, with a large data set, it is unclear if the actions performed without PC recommendations were appropriate or not. In addition, NPDS data can be impacted by human error or coding noncompliance. Further studies looking at individual case data would be needed to determine recommendation appropriateness and the impact on overall patient outcomes.

KEYWORDS Poison centers; outcome; therapy recommendation

bodatl@upmc.edu

184. Marked increase in teenage suicide attempts reported to US poison centers in 2021

Sonya Rashid[a], Sarah Berg[a], Michael Wahl[b] and Erin M. Pallasch[b]

[a]Toxikon Consortium, Chicago, IL, USA; [b]Illinois Poison Center, Chicago, IL, USA

Background: In the past 20 years, there has been a steady increase in adolescent suicide attempts by ingestion. The prevalence of anxiety and depressive symptoms among adolescents has dramatically increased during the COVID-19 pandemic. In the first full year of the pandemic, the Centers for Disease Control (CDC) reported that 40% of teens "felt sad or hopeless" in the first 6 months of 2021. The aim of the study was to analyze trends in suicide attempts and most common substances ingested among the adolescent population for the years 2019–2021 to measure changes from the pre-pandemic year to the pandemic years.
Methods: The National Poison Data System (NPDS) was queried using reason code "suicidal intent" for patients ages 13–19 for the period January 01, 2019–December 31, 2021. Further detail on generic substance code, outcome, and demographic information were obtained. ANOVA was used to evaluate the percent changes for the age groups of 13–16 and 17–19 for the years 2019 and 2021.
Results: The number of suicide attempts by ingestion reported to poison centers in 2019 was 83,130. In 2020, the number was 86,898 and in 2021 the number was 105,324. The percent change in all suicide attempts from 2019 to 2020 was 4.5%, and from 2020 to 2021 it was 21.2%. From 2019 to 2021, the percent change was 26.7%. The largest increase in suicide attempts occurred among adolescents ages 13–16. The top three substances ingested were SSRIs, acetaminophen, and over the counter (OTC) non-steroidal anti-inflammatory drugs (NSAIDs). The top 10 substances ingested made up approximately 60% of all reported substances each year. Of the top 10 substances ingested over the 3-year period, 57.0% were OTC medications and 43.0% were prescription medications. There was not a large change in medical admissions from 2019 to 2021. The percent changes between the age groups of 13–16 and 17–19 for the years 2019 and 2021 demonstrated a p-value of 0.02.
Conclusions: Suicide attempts have dramatically increased from 2019 to 2021 among adolescents ages 13–19. The study period coincides with the COVID-19 pandemic, which may have influenced the rise in suicide attempts. These findings showed that younger adolescents ages 13–16 had statistically higher rates of suicidal intent compared to older adolescents ages 17–19 (p-value <0.05). The top ten substances reported to poison centers comprised more than half of the substances used in suicide attempts in adolescents from 2019 to 2021. There was an increase in the amount of OTC medications used for suicide attempts in 2021 compared to 2019 and 2020. Several OTC medications are known to cause significant morbidity and mortality, such as acetaminophen. In some countries, acetaminophen-containing products are placed in blister packs to deter supratherapeutic ingestion. Future research and action on limiting access to OTC medications in this at-risk age group is warranted.

KEYWORDS Adolescents; suicide; COVID 19

shahnaz.s.rashid14@gmail.com

185. Hydrogen peroxide and oxiclean ingestion results in significant tissue injury

Oyeyimika Oyekanmi[a], Elisabeth Jiang[a], Matthew Griswold[a] and Dayne Laskey[b]

[a]Hartford Hospital, Uconn School of Medicine, Hartford, CT, USA; [b]Hartford Hospital, University of Saint Joseph, Hartford, CT, USA

Background: Hydrogen peroxide is an oxidizing compound known to cause emesis, gastrointestinal (GI) irritation, and portal venous gas embolization upon ingestion. Oxiclean contains sodium percarbonate, sodium carbonate, and surfactants.
Case report: A 32-year-old male presented to the Emergency Department (ED) with nausea and persistent vomiting after accidental ingestion of 3% hydrogen peroxide mixed with Oxiclean. The patient mistakenly drank the clear liquid out of a water bottle. He immediately felt a burning sensation and induced vomiting. On arrival to the ED, the patient was retching and tachycardic. He was found to be febrile with leukocytosis and a white blood cell count of 16.4 (thou/mm^3). Venous blood gas showed acidosis with pH 7.26. The patient was initiated on pantoprazole and broad spectrum antibiotics. CT chest, abdomen, and pelvis with contrast did not reveal any acute pathology. On day 2, the patient underwent upper GI endoscopy which revealed significant esophageal and gastric injury. Image 1 demonstrates significant mucosal inflammation, erythema, and friability with contact bleeding seen at the level of the lower 1/3 of the esophagus. Images 2 and 3 demonstrate the hemorrhagic, inflamed, and friable mucosa of the gastric body and fundus. The visualized portions of the first and second portion of the duodenum were normal. The patient was started on a liquid diet and transitioned to a solid diet with good tolerance. He was discharged on hospital day 5 on continued proton pump inhibitor therapy and instructed to follow up with gastroenterology in 8–12 weeks for repeat endoscopy to assess mucosal healing.
Discussion: Unintentional ingestion of dilute hydrogen peroxide is often considered minor and appropriate for home observation. This case highlights an unusual mixed ingestion with two products that resulted in unexpected mucosal injury. Sodium percarbonate, a primary component of Oxiclean, deteriorates into hydrogen peroxide upon dilution in water. Hydrogen peroxide

decomposes into water and oxygen gas on contact with mucosa. In high-concentration hydrogen peroxide ingestions, complications such as portal venous gas, gastric pneumatosis, GI perforation, and arterial gas embolism are possible. Sodium carbonate is an alkali used as a food additive and as a cleansing agent in household detergents. We propose that the primary source of the patient's injury was twofold: dilute hydrogen peroxide was made more concentrated by the addition of sodium percarbonate and made alkaline by sodium carbonate. The combination was enough to cause rapid mucosal injury which responded well to supportive measures.

Conclusions: Despite a reputation for being relatively benign, dilute hydrogen peroxide ingestion can result in significant mucosal injury when paired with other agents. In this case, we suspect that the addition of Oxiclean increased the corrosive effects of hydrogen peroxide leading to esophageal and gastric mucosal damage. Initial emergency department workup of such ingestions should include endoscopic evaluation and imaging to rule out complications from gas formation. In cases of suspected gas embolism, transfer to a facility equipped with hyperbaric therapy is warranted.

KEYWORDS Hydrogen peroxide; gastrointestinal; corrosive

oyekanmi@uchc.edu

186. Entresto we trust? Characteristics of single agent sacubitril/valsartan ingestions reported to the NPDS

Stephen Thornton[a] and Michael Darracq[b]

[a]Kansas Poison Control Center, Kansas City, KS, USA; [b]University of California-San Francisco-Fresno, Fresno, CA, USA

Background: Sacubitril/valsartan (Entresto®) was FDA-approved in 2015 and is indicated to reduce the risk of cardiovascular death and hospitalization for heart failure in adult patients with chronic heart failure and for the treatment of symptomatic heart failure with systemic left ventricular systolic dysfunction in pediatric patients aged 1 year and older. Sacubitril is a pro-drug that, upon activation, acts as a neprilysin inhibitor. Valsartan is an angiotensin receptor blocker. Sacubitril/valsartan ingestions have the potential to cause hypotension in overdoses. However, published medical literature concerning exposures to sacubitril/valsartan is limited. We sought to describe the characteristic of sacubitril/valsartan ingestions reported to the NPDS.

Methods: This was a cross-sectional study consisting of NPDS data collection utilizing quantitative data for the period of July 1, 2015 to July 1, 2021 to identify all single agent human exposures to sacubitril/valsartan followed to a known outcome. For this study pediatrics was less than 19 years of age. Data collected included demographics, reason for exposure, clinical outcomes, clinical interventions, and disposition. All data entered into NPDS was collected and analyzed using Microsoft Excel (Microsoft Corp., Redmond, Washington, 2010).

Results: A total of 178 cases (111 adults and 67 pediatric) were identified. 2020 saw the most cases with 52 though in only 6 months, there were 32 cases in 2021. Fifty-two percent ($n = 58$) of adult cases and 57% ($n = 38$) of pediatric cases were male. Adults averaged 65 (SD 16) years of age, while pediatric patients averaged 2.6 (SD 3.0) years of age. Cases of adult unintentional exposures were most common (53%, $n = 95$) while pediatric intentional cases were the rarest (1.7%, $n = 3$). The most common clinical outcome was no effect which was reported in 141 (79%) of all cases. There were 16 (9%) moderate and 2 (1%) major outcomes in this study. All moderate effects were in adult cases, with 37% ($n = 6$) of adult intentional cases resulting in a moderate outcome. Of note, both pediatric unintentional and intentional exposures resulted in no moderate outcomes and only one major outcome (in the unintentional group). No deaths were reported during the study period. Hypotension was reported in 13 (7%) cases overall, and, specifically, in 10% ($n = 2$) of intentional cases. Bradycardia and tachycardia were reported in only 1 and 2 adult unintentional cases, respectively. Only one case of vasopressor use (in an adult intentional case) was reported. In total, 14 (8%) case were admitted to a health care facility with eight adult cases (four unintentional and four intentional) being admitted to a critical care setting.

Conclusions: The number of single agent sacubitril/valsartan exposures increased over the study period. However, significant morbidity was rare, especially in pediatric cases, and no mortality was reported. Hypotension was reported but was rarely associated with vasopressor use.

KEYWORDS Sacubitril; National Poison Data System; hypotension

sthornton@kumc.edu

187. Teeth whitening product exposures reported to US poison centers, 2001–2020

Angela Lam[a], James Leonard[a] and Bruce Anderson[b]

[a]Maryland Poison Center, Baltimore, MD, USA; [b]School of Pharmacy, University of MD, Ellicott City, MD, USA

Background: Teeth whitening products are available over-the-counter. The active ingredient is usually hydrogen peroxide or carbamide peroxide. Dermal application or ingestion of peroxides may result in bothersome symptoms prompting calls to poison centers. There are limited data describing exposures to teeth whitening products. This study aimed to describe teeth whitening product exposures reported to the US poison centers.

Methods: We queried the American Association of Poison Control Center's National Poison Data System for teeth whitening product exposures in patients ages 00–89 years from 2001 to 2020. Only single substance exposures were included. Exposures to teeth whitening toothpaste were excluded. We performed a descriptive analysis.

Results: There were 9527 cases over the 20-year period. In 2001, there were 42 cases reported. The number peaked at 1227 cases in 2008, then gradually decreased to 112 cases in 2020. The majority of cases were female ($n = 6226$; 65.4%) with additional cases reported as pregnant ($n = 9$; 0.1%). Minors comprised for 35.4% ($n = 3373$) of total cases and smaller portions were between 1 month and <24 months ($n = 435$; 4.6%) and younger than 1 month ($n = 3$; 0.0%). The mean age was 29.9 years and the median was 24 years. The most common route of exposure was oral ($n = 9312$; 97.7%), followed by dermal ($n = 140$; 1.5%), ocular ($n = 114$; 1.2%), other ($n = 36$; 0.4%), and inhalation/nasal ($n = 21$; 0.2%). The majority of exposures were acute (9254; 97.1%). The five most common reasons for ingestion were unintentional – general ($n = 5288$; 55.5%), unintentional – misuse ($n = 2990$; 31.4%), unintentional – therapeutic error ($n = 585$; 6.1%), adverse reaction – other ($n = 409$; 4.3%), and intentional – misuse ($n = 89$; 0.9%). Most patients were managed on-site (8,998, 94.4%). There were 202 (2.1%) cases where poison control centers referred patients to a healthcare facility, and 208 (2.2%) cases where patients were already at a healthcare facility. Most cases were not followed to a known outcome ($n = 6929$, 72.7%). Known outcomes were mostly minor effect ($n = 966$; 10.1%), with small numbers of moderate ($n = 59$; 0.6%) and major effect ($n = 1$; 0.0%). Duration of effect was reported in 267 cases. Durations were 8 to 24 h in 39 (14.6%), 24 h to 1 week in 118 (44.2%), 1 week to 1 month in 52 (19.5%), 1 month to 3 months

in 11 (4.1%), >3 months in 12 (4.5%), and unknown in 35 (13.1%).
Conclusions: While most exposures to teeth whitening products were deemed nontoxic, a small number of cases involved prolonged clinical effects, with some required treatment and admission. Proper administration and storage may help reduce exposure incidence.

KEYWORDS Teeth whitening; hydrogen peroxide; National Poison Data System

angelalam@rx.umaryland.edu

188. The incidence of methanol poisoning in unintentional pediatric alcohol based hand sanitizer ingestions

Justin Corcoran[a], Ryan Feldman[b] and Jillian Theobald[a]

[a]Medical College of Wisconsin, Milwaukee, WI, USA; [b]Froedtert and The Medical College of Wisconsin, Milwaukee, WI, USA

Background: In July of 2020 the US Food and Drug Administration issued a consumer warning regarding methanol contaminated hand sanitizers. Reports of methanol toxicity associated with hand sanitizer ingestions began to emerge shortly after. Methanol contamination of hand sanitizer products in Iran was linked to the death of 800 people. Following these reports, our regional poison center began recommending evaluation of methanol toxicity for consumption of more than a lick or a taste of hand sanitizer. Special consideration was given to children who consumed a hand sanitizer on the FDA's list of hand sanitizers that were deemed unsafe to use. To determine the incidence of detectable methanol levels following unintentional alcohol based hand sanitizer ingestion in pediatric patients during an outbreak of methanol contaminated hand sanitizers.
Methods: This was a single-center, retrospective review of pediatric (<12 years) alcohol based hand sanitizer ingestions reported to our regional poison center, from May 1, 2020 through January 28, 2022. Data collected included whether toxic alcohol and ethanol concentrations were assessed.
Results: During the time frame of the study, 138 children under the age of 12 years were sent in for evaluation of an unintentional hand sanitizer ingestion. Of those referred to the hospital, 87 (63%) had volatile alcohol screens completed. No child had a detectable methanol concentration. Further, 11 of the 87 had a detectable ethanol concentration. Almost all of those were either symptomatic or had an intentional ingestion. Only 2 of the 138 were age <6 AND had a detectable ethanol concentration.
Conclusions: In this sample of pediatric hand sanitizer ingestions occurring during an outbreak of methanol contamination, no patient had detectable methanol levels. Children who consumed enough to have a detectable ethanol level were generally symptomatic or had an intentional ingestion. Unintentional asymptomatic children exposed to hand sanitizers are at low risk for toxicity.

KEYWORDS Methanol; hand sanitizer; pediatric

jcorcoran@mcw.edu

189. Implementation of a dedicated telephone queue for critically ill poisoned patients

Mabel Chan, Anna Leah Desembrana and Allison Davis

Ontario Poison Centre, Toronto, Ontario, Canada

Background: Over the past 10 years, call volumes at a major Canadian Poison Centre (PC) have increased steadily, and in 2021, incoming calls totaled more than 66,000. Growing call volumes have outpaced the PC's capacity to hire and train new Specialists in Poison Information. Due to increasing call volumes and complexity, average wait times to reach the PC have risen. The combination of rising wait times and increasing exposure acuity has created a risk to healthcare providers caring for critically ill patients who require immediate toxicological advice. In February 2021, the PC added a new queue dedicated to incoming calls regarding critically ill patients. The objective of this quality improvement project was to expedite service to callers who require emergent Toxicological advice.
Methods: REB exemption for this project was granted by the institution's Quality Improvement Review Board. Following the Plan-Do-Study-Act cycle for Quality Improvement, a dedicated queue was added to the PC's Interactive Voice Response (IVR) call flow intended for healthcare providers calling for critically ill patients. This option provided callers caring for a critical patient the ability to select the critical queue, which would send their call to the next available Poison Specialist. Criteria for what qualifies as a "critical" patient were created by consensus among the PC's Toxicology team and communicated to healthcare providers in the PC jurisdiction prior to implementation of the critical queue. Average monthly wait times in the critical queue were then compared with average monthly wait times in the regular queue. Inappropriate use of the critical queue was anticipated. As a balancing measure, two unique codes were created in Visual Dotlab Enterprise for the purposes of tracking both appropriate and inappropriate critical queue use. All calls that came through the critical queue were documented as "appropriate" if they met critical criteria, or "inappropriate" if they did not. Data were collected on a weekly basis to monitor for inappropriate calls coming through the critical queue. Due to initially high numbers of inappropriate calls, the IVR call flow was modified to more suitably direct callers.
Results: Calls from the 1-year period between March 2021 and February 2022 were evaluated and wait times in the critical queue were compared to wait times in the regular queue. Overall, wait times for calls in the critical queue were 67% shorter than for calls in the regular queue. During the first 2 months of implementation, the percentage of calls that came through the critical queue inappropriately was 89% and 91% respectively. Changes to the IVR call flow were made to reduce inappropriate use of the critical queue. Analysis of appropriate and inappropriate use of the critical queue is ongoing and a comparison of appropriate and inappropriate calls through the critical queue after the IVR call flow was changed is forthcoming.
Conclusions: Data shows that implementation of a separate queue significantly reduced wait times for critically ill patients requiring urgent toxicological advice.

KEYWORDS Quality Improvement; wait times; critical queue

mabel.chan@sickkids.ca

190. Patterns of 2,4-dinitrophenol use as discussed on social media

Michael Chary and Ali Abdelati
Weill Cornell Medical Center, New York, NY, USA

Objective: 2,4-dinitrophenol (DNP) is an oxidative phosphorylation uncoupler used for weight loss. The USA Food and Drug Administration declared DNP too dangerous for human consumption in 1938. Increasing fatalities suggest ongoing use. However, a federal ban and known toxicity raise substantial barriers to experimental study. Our objective was to determine the sublethal dosage, usage, and coingestants of DNP in humans using self-reported usage described on the Internet.
Methods: We analyzed Internet posts from 2017 to 2020 from discussion forums dedicated to bodybuilding. Posters were anonymous and consented to re-use their data when they agreed to each website's terms of service. We combined our previously developed natural language processing techniques with a novel ontology to extract doses, effects, and the names of substances used from each post. Each post was tokenized into mentions of substances and effects and mapped to standardized mentions of substances (using RxNorm) and effects using an ontology.
Results: We identified 680 posts (634 unique), describing a median dose of 250 mg (25th–75th percentile 200–500 mg), 114 effects and 94 coingestants. The most common side effects reported were sweating (101/634; 16%), feeling hot (82/634; 12.9%), lethargy (57/634; 9.0%), and night sweats (55/634; 8.6%). There were fewer than 5 total mentions of tachycardia, palpitations, or yellow discoloration. The most commonly reported coingestants were androgenic anabolic steroids (AAS) (testosterone 51/634, 8.6%; trenbolone 79, 12.4%) and substances previously reported as used for lipolysis (clenbuterol 37/634, 5.8%; levothyroxine 75/634, 11.8%; ephedrine-caffeine-aspirin 29/634, 4.6%). There were fewer than 5 mentions of selective estrogen or androgen receptor modulators.
Conclusions: An analysis of Internet discussions on DNP usage found most reported ingested doses between 200 and 500 mg, which were associated with sweating, feelings of warmth, and lethargy, but no palpitations or yellow discoloration. Co-mention of substances known to be used in bodybuilding (AAS, clenbuterol, ECA) support the validity of our method. Our results may be affected by reporting bias and non-authentic posting (trolling). Our approach complements data from Poison Control Centers and Medical Examiners, which may be biased towards more severe poisonings. Our analysis also provides a ontology, a standardized list of terms used to report and describe 2,4-dinitrophenol ingestion that made aide future efforts to excavate toxicological information from unstructured text on the Internet.

KEYWORDS Social media; natural language processing; toxicosurveillance

mac389@gmail.com

191. Massive ibuprofen ingestion resulting in multi-system organ failure

Andrew Chambers[a,b], Natasha Tobarran[a,b], Emily Kershner[a,b], Brandon Wills[a,b] and Rutherfoord Rose[a,b]
[a]Virginia Commonwealth University, Richmond, VA, USA; [b]Virginia Poison Center, Richmond, VA, USA

Background: The majority of ibuprofen overdoses have a benign and uneventful course however there are limited cases reporting systemic effects following massive ibuprofen overdoses. This report describes a case of massive ibuprofen overdose resulting in multisystem organ failure including coma, lactic acidosis, polyuria, hypoglycemia, and cardiac arrest with survival.
Case report: A 15-year-old otherwise healthy male presented to the emergency department unresponsive after a suicide attempt in which he ingested approximately 300 ibuprofen 400 mg tabs (120 g or 1666 mg/kg) and 15 diphenhydramine 25 mg, confirmed by pill count and text messages. He was intubated for airway protection and transferred to an outside pediatric ICU, where he was originally hyperglycemic to 358 mg/dL but quickly became hypoglycemic with a nadir of 38 mg/dL, treated with several ampules of D50W and started on a continuous dextrose infusion. He rapidly developed shock, worsening metabolic acidosis (pH 6.98), acute kidney injury, wide-complex junctional rhythm and multiple cardiac arrests. After return of spontaneous circulation vasopressin, norepinephrine, and dopamine were administered for refractory shock prior to transfer to a tertiary care facility. Vital signs upon arrival were blood pressure 118/57 mmHg, heart rate 114 bpm, respiratory rate 13 and SpO2 99%. Labs on arrival were K 6.6 mmol/L, AG 17, Creatinine 2.19 mg/dL, AST 363 U/L, ALT 164 U/L, CK 9075 mg/dL, ABG with pH 7.10, PCO2 41, PO2 141, lactate 11.2 mmol/L. Toxic alcohols, acetaminophen and salicylate were all non-detectable, and serum drug of abuse screen negative. An ibuprofen serum concentration drawn 41 h post ingestion was 271.5 μg/mL (reference range 10–50) – obtained after 3 h of hemodialysis and 12 h of continuous veno-venous hemofiltration. Urine output was 22 mL/kg/h during first 24 h. He underwent intermittent hemodialysis for an additional 13 days and his course was complicated by deep vein thrombosis, multiple punctate cerebral hemorrhages, and necrotizing pneumonia. He was successfully extubated on hospital day 30 and discharged to an inpatient psychiatric facility after 43 days with complete recovery.
Discussion: Ibuprofen ingestions do not usually manifest in systemic toxicity. Although renal failure and acidosis are well described in large overdoses (>400 mg/kg), profound toxicity including primary cardiac arrest and multiorgan dysfunction are exceptional. Polyuria and hypoglycemia are also rarely reported and the toxicologic mechanisms are not fully understood. It has been previously hypothesized that non-steroidal anti-inflammatory drugs may indirectly stimulate insulin release in vitro.
Conclusions: This case illustrates profound toxicity from a massive ibuprofen overdose, including polyuria and hypoglycemia, that was successfully treated with aggressive supportive care without long term sequelae.

KEYWORDS Ibuprofen; shock; cardiac arrest

andrew.chambers@vcuhealth.org

192. Hypotension and vasopressor use in miscellaneous antihypertensive overdose, a poison center observational study

Natasha Tobarran[a,b], Anna Cline[a], Emily Kershner[a,b], Andrew Chambers[a,b], Rutherfoord Rose[a,b], Brandon Wills[a,b] and Kirk Cumpston[a,b]
[a]Virginia Commonwealth University, Richmond, VA, USA; [b]Virginia Poison Center, Richmond, VA, USA

Background: Antihypertensives that cause the greatest morbidity and mortality in overdose include the calcium channel and beta antagonist classes. These agents can result in severe, refractory shock requiring aggressive supportive interventions. Other, "miscellaneous" antihypertensive overdoses tend to be more benign and include medications from a variety of different classes, each

with variable clinical effects. Medications from the miscellaneous class include central alpha-2 agonists, peripheral alpha-1 antagonists, hydralazine, long-acting nitrates (isosorbide mononitrate), angiotensin-converting enzyme (ACE) inhibitors, and angiotensin receptor blockers (ARB). The proportion of serious outcomes including hypotension or vasopressor use following overdose of miscellaneous antihypertensives is unknown. The primary aim of this study is to evaluate the proportion of hypotension and vasopressor use following antihypertensive overdose from the miscellaneous antihypertensive classes.

Methods: This was a retrospective cohort study conducted by chart review of electronic records to the Virginia Poison Center from January 1, 2004 to December 31, 2020. Inclusion criteria were single acute miscellaneous antihypertensive exposures evaluated in a health care facility, age >14. Exclusion criteria included missing data, minor or no effect outcomes, polypharmacy overdose, and if one extra dose of medication was taken. Cases with outcome > minor effect were further abstracted to identify hypotension and/or vasopressor use. The primary outcome was hypotension which was defined as systolic blood pressure <90 mmHg and/or MAP < 65.

Results: During this study period, there were 704 single acute miscellaneous antihypertensive exposures. There were 66/704 (9%) cases that met the hypotensive criteria. There were no deaths and no patients required cardiopulmonary resuscitation. Hypotensive patients were treated in the ICU ($n = 37$, 56%), floor ($n = 12$, 18%), or either admitted to psychiatry or discharged from the ED ($n = 17$, 26%). Vasopressor therapy was administered in 9/704 cases (1%). In the cases where vasopressor use was recorded, norepinephrine was used 4 times, dopamine 4 times, and phenylephrine once.

Conclusions: In this series, we found that hypotension following miscellaneous antihypertensive overdose is relatively uncommon and vasopressors are rarely required. Clonidine appears to be the most common antihypertensive agent associated with hypotension following overdose.

KEYWORDS Antihypertensive; hypotension; vasopressor

natasha.tobarran@vcuhealth.org

193. Kratom exposures reported to the US poison centers

Saumitra Rege, Ryan Cole, Christopher Holstege and Benjamin Holstege

University of Virginia, Charlottesville, VA, USA

Background: National Center for Health Statistics indicates that there were an estimated 100,306 drug overdose deaths in the US between 2020 and 2021. According to a recent study utilizing the federal database including records of all known fatal drug overdoses across 27 states from July 2016 through December 2017, there were 91 kratom-related overdose deaths. The objective of our study was to evaluate the trends in kratom-related overdoses reported to the US poison centers (PCs).

Methods: The National Poison Data System (NPDS) was queried for all closed, human exposures to kratom from January 01, 2015 through December 31, 2021 using the American Association of Poison Control Center (AAPCC) generic code identifiers. We identified and descriptively assessed the relevant demographic and clinical characteristics. Reports from acute care hospitals and hospital based EDs (ACHs) were evaluated as a subset. Trends in kratom exposure frequencies and rates (per 100,000 human exposures) were analyzed using Poisson regression methods. Percent changes from the first year of the study (2014) were reported with the corresponding 95% confidence intervals (95% CI).

Results: During the study period, there were 5910 toxic exposures to kratom that were reported to the PCs. The frequency of exposures increased by approximately 2000% (95% CI: 1911.1%, 2101.3%; $p < 0.001$), and the rate of exposures significantly increased by 1917% (95% CI: 1818.2%, 2005.9%; $p < 0.001$). Of the total kratom calls, the proportion of calls from ACHs decreased from 81.3% to 61.8%, with the percentage of calls from the general public increasing. Multiple substance exposures accounted for 38.4% of the overall kratom calls and 58.1% of calls from ACHs. Approximately 15% of the patients reporting kratom exposures were admitted to the critical care unit (CCU), with 6% of patients being admitted to a psychiatric facility. Residence was the most common site of exposure (88.3%), and 73% of these cases were enroute to the hospital via EMS when the PC was notified. Cases were predominantly male (68.3%), with the most common age group being 20–29 years (25.2%). The proportion of such cases (34.7% to 28.1%) decreased during the study period. Intentional abuse (42.2%) was the most common reason for exposure, followed by intentional misuse, with exposures for both reasons being higher in cases reported by ACH. Minor effects and moderate effects were seen in 22% and 36.2% cases, respectively. There were 60 deaths during the study. The most frequently co-occurring substances associated with the cases were alcohol (9%) and unidentified toxic plant substances (5.7%).

Conclusions: Our study results demonstrate a significant increase in the reports of kratom exposures made to the PCs. The exposures in the young age groups were common and the most frequent reason for exposure was intentional abuse. Continued surveillance and public health prevention efforts are key to track the population effects of kratom exposures.

KEYWORDS Kratom; drugs of abuse; National Poison Data System

svr5d@hscmail.mcc.virginia.edu

194. Opioid ototoxicity reported to poison centers

Lesley Pepin[a], Fermin Suarez[a], Anastasia Cornell[b] and Christopher Hoyte[b]

[a]Denver Health, Denver, CO, USA; [b]Rocky Mountain Poison and Drug Safety, Denver, CO, USA

Background: Opioid exposure is associated with sensorineural hearing impairment. Mechanisms of ototoxicity are not completely understood. While many recover, some patients sustain permanent dysfunction. Treatment modalities considered in sensorineural hearing loss include steroids and cochlear implants when impairment is irreversible. Understanding the details of opioid exposure may elucidate the risk of hearing loss, pathophysiology of ototoxicity, and current management strategies. The objective of this study is to investigate opioid associated ototoxicity reported to US poison centers.

Methods: This is a retrospective review of opioid exposures with ototoxicity reported to the National Poison Data System (NPDS) from January 1, 2000 to December 31, 2000. We included patients with opioid related hearing changes defined as tinnitus and/or deafness. Descriptive statistics were used to characterize demographics, exposures, therapies and associated clinical effects. Of specific interest was presence of opioid toxidrome features, respiratory insufficiency and hemodynamic instability. Rate of steroid use was also evaluated. Frequency of ototoxicity by specific opioid type was calculated. Finally, single substance exposure cases were independently analyzed. Institutional Review Board approval was obtained.

Results: There were 1,547,453 total cases of opioid exposure reported, and 1118 cases of opioid related deafness and/or tinnitus (0.07%). Patients were predominantly female (631, 56%) with median age 29 years (interquartile range 20). Most common opioid exposures included hydrocodone (261), oxycodone (227), heroin (155) and codeine (146). Deafness was reported in 20% (227) of cases of ototoxicity cases while tinnitus was reported in (N,80%). About 13.5% of cases had ototoxic effects resolving in three days with 15 cases reporting permanent effects. There were 762 (68%) patients with a nonopioid co-exposure also associated with hearing loss or tinnitus. Most common ototoxic co-exposure was salicylates (656) and non-steroidal anti-inflammatories (139). Majority of cases involved acute (781, 70%) or acute-on-chronic opioid exposure (168, 15%), intentional use (944, 84%) and ingestion (973, 87%). Features of opioid toxidrome, respiratory insufficiency and hemodynamic instability were reported in 49% (549), 23% (257) and 42% (470) respectively. These features were absent in 38% (424) of ototoxicity cases. Steroids were given in 1.5%. There were 270 single substance opioid exposure cases; 48 included a salicylate-opioid combination product. Ingestion was the most common route of opioid exposure (176, 65%). Majority of exposures were intentional (197, 73%) and acute or acute-on-chronic (223, 83%).
Conclusions: Ototoxicity is rarely described in opioid exposures reported to poison centers. Various opioid types are associated with hearing loss. An acute component to exposure is commonly seen. Absence of opioid toxidrome, respiratory insufficiency or hemodynamic instability were not unusual and could suggest more localized opioid effects as cause of ototoxicity. It is likely ototoxicity goes under reported as resolution within 24 h is common. Steroids were infrequently used despite support for early initiation in sensorineural hearing loss. This study was limited to data provided voluntarily to poison centers.

KEYWORDS Deafness; opioid; ototoxicity

lesley.pepin@rmpds.org

195. The buprenorphine blues: severe precipitated opioid withdrawal requiring intubation in fentanyl users

Grant Comstock[a], Sasha Kaiser[a], William Boroughf[b], Benjamin Hatten[b] and Jeffrey Brent[b]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA;
[b]University of Colorado School of Medicine, Denver, CO, USA

Background: Fentanyl is increasingly found in illicit pressed pills, often called "blues" or "M30s." It is a potent, lipophilic opioid with known adipose deposition. The potential for prolonged fentanyl presence at opioid receptors despite abstinence has led to concern for risk of precipitated withdrawal when administering buprenorphine. We present 4 cases of severe buprenorphine precipitated fentanyl withdrawal (BPFW) requiring intubation in chronic fentanyl users.
Case series: Case 1: 59-year-old male, ingesting up to 8 "M30 blues" daily (last use 8 h prior to presentation) developed recalcitrant hyperactive delirium after administration of Suboxone 16mg/4mg at home, requiring intubation with deep sedation and high-dose hydromorphone infusion for symptom control. Case 2: 49-year-old male, smoking up to 10 "blues" daily presented in moderate withdrawal 18 h from last use. He developed worsening myalgia and restlessness after emergency department administration of 8mg/2mg Suboxone and progressed to violent hyperactive delirium after an additional 24mg/6mg Suboxone, requiring intubation and deep sedation. His agitation was difficult to manage until hospital day 3 when a hydromorphone infusion was initiated. Case 3: 39-year-old pregnant female at 31 weeks gestation, smoking 20–30 "fentanyl tablets" daily developed withdrawal symptoms progressing to hyperactive delirium shortly after receiving buprenorphine in jail 6 h after her last fentanyl use, requiring intubation and deep sedation for symptom control. Her clinical course was complicated by preeclampsia with severe features, requiring emergent cesarean section. Case 4: 27-year-old pregnant female at 3 weeks gestation, insufflating 14–35 "blues" daily developed escalating agitation and delirium following buprenorphine exposure 12 h from last use. She required intubation and prolonged deep sedation for symptom control. Her course improved with the addition of a hydromorphone infusion.
Discussion: The potential for continued redistribution of fentanyl following prolonged abstinence has led to concern for increased risk of BPFW, even in extended fentanyl abstinence. Case studies have reported BPFW in users despite 2–3 days abstinence, and survey-based data show increased risk of precipitated withdrawal when buprenorphine is given within 48 h of fentanyl cessation. We report four cases of BPFW in chronic fentanyl users resulting in hyperactive delirium. In all cases, providers attempted multimodal pharmaceutical approaches to manage severe withdrawal symptoms without success, ultimately requiring intubation and deep sedation. Management strategies for severe BPFW in this patient population are ill-defined. Medical Toxicology was involved in the care of each patient after initial deterioration. Given the high mu opioid receptor affinity of hydromorphone, high dose infusion after intubation was attempted in all four cases with temporal association with clinical improvement.
Conclusions: We present four cases of severe BPFW requiring intubation in patients reporting chronic use of high doses of illicit fentanyl exposed to buprenorphine within 24 h of last use. All patients were managed using multimodal sedation after intubation including high doses of full opioid agonists, specifically exploiting the pharmacologic properties of hydromorphone. Consideration of time of last use is paramount when initiating buprenorphine for this patient population.

KEYWORDS Buprenorphine; fentanyl; precipitated withdrawal

grantcomstock@gmail.com

196. The current state of required, elective, or longitudinal toxicology rotations in PGY2 emergency medicine pharmacy residency training

Natalija Farrell

Boston Medical Center, Boston, MA, USA

Background: In 2018, the American Society of Health-System Pharmacists (ASHP) moved the management of toxicology patients from an elective to a required competency area in the Postgraduate Year 2 (PGY2) Emergency Medicine (EM) "Required Competency Areas, Goals, and Objectives." Residency programs may not have a board certified medical or clinical toxicologist on site to precept or the ability to send residents off site for rotations. On site rotations may not offer the variety and acuity of cases that poison centers can provide. It is currently unknown if PGY2 EM programs have the foundation to support the toxicology education requirement.
Methods: On March 1, 2022, the ASHP residency directory website was queried for all PGY2 EM programs. The ASHP residency directory includes the program accreditation status, number of residents, and the individual program's website. The individual PGY2 EM program websites were reviewed to determine toxicology rotation type, duration, and location. The website was also used to identify board certified clinical or medical toxicologist

preceptors. Descriptive statistics were used to summarize the results.
Results: The ASHP residency directory yielded 102 PGY2 EM pharmacy resident positions from 88 programs. There were 65 accredited, 14 candidate, and 9 pre-candidate PGY2 EM pharmacy residency programs. A toxicology rotation was listed as a required rotation for 62.5% ($n = 55$) of programs. The remaining 30.68% ($n = 27$) and 6.82% ($n = 6$) of programs did not require a toxicology rotation or did not specify required rotations, respectfully. An elective toxicology rotation was listed for 21.6% ($n = 19$) of programs, and a total of 8 programs listed both required and elective rotations in toxicology. 70.45% ($n = 62$) of programs did not list an elective toxicology rotation, and 7.95% ($n = 7$) of programs did not specify elective rotations. 18.18% ($n = 16$) of programs listed a longitudinal toxicology rotation; while, 75% ($n = 66$) and 6.82% ($n = 6$) of programs did not have a toxicology longitudinal rotation or specify longitudinal rotations, respectfully. The longitudinal toxicology rotations were listed in addition to a required rotation at 9 programs and an elective rotation at 1 program. 72.27% ($n = 64$) of programs offered a required, elective, or longitudinal toxicology rotation. When specified, most toxicology rotations were at a poison center ($n = 33$) and the minority were with toxicology consult services ($n = 4$) or the Toxikon ($n = 1$). When specified, the toxicology rotation experiences ranged from 1 to 52 weeks, with most dedicated required or elective rotation blocks lasting 4 to 6 weeks. Only 16% ($n = 14$) of programs had at least 1 board certified clinical toxicologist as a preceptor. No programs reported a board certified medical toxicologist as a preceptor.
Conclusions: Nearly 70% of PGY2 EM pharmacy residency programs offer a required or longitudinal toxicology rotation, which suggests that some programs may not be able to adequately fulfill the toxicology competency area of training. Few programs have board certified clinical toxicologists, and toxicology rotations varied in length and setting. Additional guidance from the American Board of Applied Toxicology and American Academy of Clinical Toxicology could help standardize the minimum expectations for PGY2 EM pharmacy residency toxicology learning experiences.

KEYWORDS PGY2 emergency medicine pharmacy residency; clinical toxicology; pharmacy resident

natalija.mead.farrell@gmail.com

197. Methemoglobinemia following massive intentional antifreeze ingestion

Marielle Brenner[a], Alex Ponce[b], Robert Avera[a] and Louise Kao[b]

[a]Indiana University, Indianapolis, IN, USA; [b]Indiana Poison Control Center, Indianapolis, IN, USA

Background: Methemoglobinemia after antifreeze ingestion is a rare event. Prior reports have implicated sodium nitrite in the antifreeze solution as the cause of the methemoglobinemia in massive antifreeze ingestions.
Case report: 49-Year-old male presented to an emergency department 2 h after an intentional ingestion of radiator antifreeze. He had no other ingestions and was not on any daily medications or supplements. He had altered mental status and violaceous skin on exam. Initial vital signs included in blood pressure 120/66 mmHg, heart rate 79 beats per minute, respiratory rate of 23 breaths per minute, and oxygen saturation of 97% on 4 liters of oxygen given via nasal cannula. Laboratory work up was notable for bicarbonate concentration of 5 mEq/L, creatinine concentration of 1.1 mg/dL, lactate of 20 mmol/L, osmolar gap of 133 mOsm/L, and ethylene glycol concentration of 580 mg/dL, hemoglobin concentration of 15.5 g/dL, and methemoglobin concentration of 21.2%. He received methylene blue, fomepizole, thiamine, folate, and hemodialysis. Repeat methemoglobin concentration 4 h later was 1.2%, lactate had decreased 1 mmol/L, bicarbonate 21 mmol/L, creatinine was 1.0 mg/dL, hemoglobin 13.6 mg/dL and ethylene glycol concentration was 60 mg/dL. He received a total of 6 doses of fomepizole and 3 sessions of intermittent hemodialysis before ethylene glycol concentration became undetectable. He was discharged on to psychiatric facility on hospital day 5 with normal kidney function.
Discussion: Methemoglobinemia after massive antifreeze ingestion is rarely reported but thought to result from sodium nitrite in the antifreeze solution. Even though the reported concentration of sodium nitrite in antifreeze solution comprises less than 1% of the total solution, a massive ingestion, such as in our patient, can potentially lead to symptomatic methemoglobinemia. Clinicians should be aware of this possible toxicity in antifreeze ingestion as the sodium nitrite is often not reported on the material data safety sheet due to its low concentration. The presence of methemoglobinemia with ethylene glycol co-ingestion did not necessitate any change to typical treatments for both toxicities in our patient.
Conclusions: Massive ingestions of antifreeze can also lead to significant methemoglobinemia that may require treatment with methylene blue. Previous studies have implicated the presence of sodium nitrate in the antifreeze solution rather than the ethylene glycol as the likely cause of the methemoglobinemia. The treatment for both toxicities remained the same for our patient who had a good outcome.

KEYWORDS Antifreeze; methemoglobin; nitrate

brenner.marielle@gmail.com

198. Increasing suicidal ingestions among younger patients using own prescribed medications

Alisia Bahadir[a], Sarah Holzman[a], Seth Carroll[a] and Elizabeth Grossart[b]

[a]Arizona Poison and Drug Information Center, Tucson, AZ, USA; [b]Department of Emergency Medicine, University of Arizona, Tucson, AZ, USA

Objectives: Observations of overdoses reported to our regional poison center over the past 5 years suggest increasing incidence of intentional overdoses among children and adolescents. We analyzed data from poison center calls to identify trends in demographics. We also analyzed medications used, co-intoxicants, and outcomes during this time period to determine if ingestion of a patient's own prescribed medication(s) versus another person's prescribed medication(s) or the presence of common co-intoxicants affected outcomes.
Methods: Using ToxSentry query builder, intentional suspected suicide cases in patients 17 years and under reported to a regional poison center from January 2017 through December 2021 were identified. For each case, age, gender, substance(s) involved, clinical effects, and outcome were recorded. Substances were further analyzed to see if a prescription medication was involved, and if so, if it belonged to the patient. All cases were individually reviewed for coding accuracy.
Results: We analyzed 2556 pediatric suspected suicide cases that were followed to outcome. Incidence rates increased 15.6% (98.75 to 114.14 per 100k population aged 0–17 years) from 2017 to 2021. This increase was exclusively in females; male incidence rates remained unchanged. There was a significant decrease in average age from 15.0 ± 1.6 years in 2017 to

14.5 ± 1.7 years ($p < 0.0001$, CI: −0.68 to −0.27) in 2021. Prescription medications were involved in 1379 (54%) exposures. The most common prescription medications used in suspected suicide ingestions were SSRIs 16.7%, atypical antipsychotics 7.2%, hydroxyzine 4.7%, and benzodiazepines 3.3%. Children ingested their own prescription medications in 679 (48.2%) cases. They ingested another person's prescription medication in 320 (23.2%) cases, and in 380 (27.6%) cases, medication possession was not recorded. When comparing medical outcomes, cases involving another person's prescription medication had significantly more "moderate to major effects" than cases involving the child's own prescription (38.3% vs 31.4%, $p < 0.05$). 1177 (46%) exposures involved only over-the-counter (OTC) medications. 22.6% of cases involved acetaminophen-containing products, 14% involved ibuprofen-containing products, and 9.3% involved diphenhydramine-containing products. THC urine drug screen was available for 63% of our population; of those with results, 20.2% were positive and 79.8% were negative. There was no difference in medical outcome comparing THC + vs THC- groups. Ethanol co-ingestion data were available for the entire population, but only was detected or reported in 7.4% of cases. Those involving detectable ethanol concentrations were more likely to have 'moderate to major outcomes' than cases without ethanol (33.3% vs 25.2%, p <0.05).

Conclusions: Pediatric suspected suicide cases are increasing in incidence in our region. Females and younger patients are contributing to this trend. In contrast to previous studies, exposures involving prescription medications and those involving only OTC medications were nearly evenly split in our population. Preferential use of own prescribed medications in overdose may reflect increased prescribing/access in response to the emerging youth mental health crisis. Exposures involving another person's medication(s) tended to have more serious outcomes. Further research is warranted to determine how co-intoxicants contribute to suicidal medication overdoses in children.

KEYWORDS Suicidal overdose; pediatric; poison control

bahadir@pharmacy.arizona.edu

199. Snap, crackle, pop: a retrospective review of firework ingestions reported to a single poison center

Brandtly Yakey, Varun Vohra, Matthew Hedge and Andrew King

Michigan Poison and Drug Information Center at Wayne State University School of Medicine, Detroit, MI, USA

Background: Fireworks are pyrotechnic devices frequently used for entertainment and recreational purposes. Poison centers in the US frequently receive calls related to firework exposures. Although traumatic injuries are well-documented, reports of systemic toxicity following firework ingestions are limited. Patients may be referred to emergency departments for evaluation after unintentional ingestions. Fireworks are typically composed of an oxidizing agent, a reducing agent, various metals, a binder, and a fuel. Our objective was to retrospectively review and characterize cases and clinical outcomes of firework ingestions reported to our poison center over time.

Methods: A retrospective review of firework ingestion cases reported to a single poison center between January 1, 2011, and December 31, 2020. Non-human exposures and calls to request information were excluded from the review. Clinical and demographic data were abstracted including age, sex, clinical effects, exposure reason, management site (healthcare facility or non-healthcare facility), and medical outcomes.

Results: A total of 239 cases involving ingestion of fireworks met study inclusion criteria. The mean age was 4 years (range 6 months–88 years), and 144 (60.3%) were male. Most cases were managed at home (202; 84.5%). A total of 26 (10.9%) cases were referred to a healthcare facility, of which two were admitted for observation, and one admitted to a critical care unit. Follow up was not performed in 142 (59.4%) cases due to non-toxic exposures or being lost to follow up. Of the cases followed to a known outcome, 82 (34.3%) had no effect, ten (4.2%) resulted in minor effects, and four (1.7%) resulted in moderate effects. There was one death after ingestion of 40 snappers in an 88-year-old male. Reported firework products included: snakes (47; 19.7%), snappers (35; 14.6%), firecrackers (22; 9.2%), smoke bombs (7; 2.9%), fire coloring additive (3; 1.2%), caps (2; 0.84%), and products coded generally as "fireworks"(86; 35.9%). Clinical manifestations included: vomiting (16; 6.7%), abdominal pain (2; 0.84%), throat irritation (2; 0.84%), cough/choking (2; 0.84%), diarrhea (1; 0.42%), drowsiness (1; 0.42%), electrolyte abnormality (1; 0.42%), and cardiac arrest (1; 0.42%). Patients were asymptomatic in 118 (91.2%) of cases.

Conclusions: Systemic toxicity secondary to firework ingestions were rare in our study cohort, with most ingestions remaining asymptomatic and managed at home. Future studies are warranted to determine which specific types of firework products and ingredients are associated with clinically significant outcomes and warrant referral to a healthcare facility.

KEYWORDS Fireworks; ingestion; pyrotechnics

ci7465@wayne.edu

200. High dose insulin/glucose for poisoning: an analysis of the first three years (2019–2021) of cases reported to the national poison data system

Jon Cole[a,b], Alexandru Ulici[a], Samantha Lee[a], Matthew Prekker[a,b,c], Brian Driver[b] and Travis Olives[a,b]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]Department of Emergency Medicine, Hennepin Healthcare, Minneapolis, MN, USA; [c]Department of Medicine, Hennepin Healthcare, Minneapolis, MN, USA

Background: High dose insulin/glucose (HDI) is a standard therapy for beta blocker (BB) and calcium channel blocker (CCB) poisoning. Current evidence supporting the use of HDI consists of animal studies, case reports and series, small retrospective studies, and reviews of two single US poison centers' practice. No large database studies have examined the use of HDI for poisoning. The purpose of this study is to describe US trends in HDI use for poisoning utilizing the National Poison Data System (NPDS).

Methods: We identified all cases reported to the NPDS where "High Dose Insulin/Glucose" therapy was recommended, performed, recommended and performed, or recommended/known not performed in NPDS from 2019 to 2021. Dates reflect the first 3 years where NPDS allowed for specific coding of HDI (as opposed to merely "insulin" prior to 2019). We report call information, clinical effects, therapies, and outcomes as defined in the NPDS. Descriptive statistics were used to analyze data (Microsoft Excel, version 2203).

Results: A total of 2556 patients were identified after excluding confirmed non-exposures. A total of 1856 patients received HDI

(1,108 coded as "Recommended and Performed," 748 coded as "Performed only"); 550 were coded as "Recommended only," and 150 were coded as "Recommended but not Performed." Outcomes were more severe in patients where HDI was performed (431 cases [23%] resulted in death, 884 [48%] resulted in major outcomes) compared to cases where HDI was recommended but not performed (86 cases [12%] resulted in death, 199 [28%] resulted in major outcomes; $p < 0.00001$). HDI was performed in all 50 US states. Of the 1856 included HDI cases 579 occurred in 2019, 633 occurred in 2020, and 644 occurred in 2021. Median age was 53 years; 55.2% were female. Only 10 cases occurred in children under 13 years of age. HDI was used primarily for CCBs ($n = 1116$; 60%) and BBs ($n = 985$; 53%) with the most common drugs being amlodipine ($n = 677$; 61%), metoprolol ($n = 371$; 38%), carvedilol ($n = 207$; 21%), propranolol ($n = 196$; 20%), diltiazem ($n = 189$; 17%), and verapamil ($n = 136$; 12%). Notable concomitant cardiovascular therapies included vasopressors ($n = 1612$; 87%), calcium ($n = 1206$; 65%), glucagon ($n = 1008$; 54%), lipid emulsion therapy ($n = 378$; 20%), CPR ($n = 210$; 11%), methylene blue ($n = 154$; 8%), and ECMO ($n = 98$; 5%). Subanalysis of CCB patients receiving HDI revealed methylene blue was used more commonly for amlodipine (110/677; 16%) than for non-dihydropyridines (7/249; 2.8%: $p < 0.00001$). There were 495 (27%) cases with a single substance coded (261 CCBs, 140 BBs). Among these cases, mortality was higher among CCBs ($n = 65$; 25%) than BBs ($n = 13$; 9%: $p = 0.00016$); notably mortality did not vary across individual single-substance CCB or BB cases.

Conclusions: In the first 3 years of available NPDS data, High Dose Insulin/Glucose was most commonly used for severe calcium channel blocker or beta blocker poisoning in patients age 13 years or older. Mortality was common, and higher in calcium channel blocker poisoning than in beta blocker poisoning. In patients with calcium channel blocker poisoning treated with HDI, concomitant methylene blue use was more commonly with amlodipine than with non-dihydropyridines, suggesting amlodipine-poisoned patients treated with HDI had refractory vasoplegia.

KEYWORDS High dose insulin; calcium channel blockers; beta blockers

jonbcole@gmail.com

201. Rivastigmine for the management of anti-cholinergic delirium: a case series

Angela Chiew[a] and Betty Shuk Han Chan[b]

[a]Prince of Wales Hospital, Carlton, Australia; [b]Prince of Wales Hospital, Randwick, Australia

Background: Anti-cholinergic agents are commonly taken in overdoses and anti-cholinergic delirium (ACD) is a common complication. ACD is a spectrum of mild to severe delirium and agitation. The management of ACD often involves chemical sedation with some patients requiring large doses of sedative agents. Physostigmine, an acetylcholinesterase-inhibitor that crosses the blood-brain barrier has been shown to be effective in the management of ACD. However, availability of physostigmine is limited in many countries including Australia. Rivastigmine, has been proposed in a few case reports as an alternative agent to manage ACD. It has the same mechanism of action as physostigmine and is available as a dermal patch and oral tablet. We report a case series of patients with ACD who were managed with rivastigmine (oral and dermal patch).

Case series: From Dec 2019 to Jan 2022 eight patients were administered rivastigmine for the management of ACD. Five were male, with a median age of 40 y (IQR: 30–44 y). Other features consistent with anti-cholinergic toxicity present included tachycardia (8), urinary retention requiring catheterisation (5) and temperature >37.5C (3). Most patients were administered physostigmine (6) when available prior to rivastigmine administration. Three patients were managed with dermal rivastigmine and the remainder with oral rivastigmine Three patients had ongoing agitation despite rivastigmine, two of which were managed with dermal rivastigmine, for which additional patches were applied. No patients had an adverse event (i.e., bradycardia or gastrointestinal symptoms) from rivastigmine administration.

Discussion: ACD can be difficult to manage and a longer acting, readily available agent such as rivastigmine may be useful given physostigmine's limited availability. However, a major limitation to oral rivastigmine is the administration of an oral medication in a non-complaint agitated patient. For this reason, the dermal patch was utilised in three patients however two had ongoing agitation. This may be because of the long duration to peak rivastigmine concentration with the dermal vs oral formulation, 8.1 vs 1.4 h respectively. Hence in those patients where IV physostigmine was available it was first administered to improve the delirium and to allow the administration of oral rivastigmine.

Conclusions: We report a case series of ACD managed with a combination of oral and dermal rivastigmine. No patients had an adverse outcome and both dermal and oral rivastigmine appear to be safe in patients with ACD. Further research is required to determine the optimum dosing regimen. h

KEYWORDS Anti-cholinergic delirium; antidote; rivastigmine

angela.chiew@health.nsw.gov.au

202. Intubated emergency department patients with alcohol poisoning vs. other critical intoxications: a comparison of ICU outcomes

Gabbie Gervais[a], Lauren Harvey[a], Matthew Prekker[b], Jon Cole[c], Travis Olives[c] and Brian Driver[b]

[a]University of Minnesota Medical School, Minneapolis, MN, USA; [b]Hennepin Healthcare, Minneapolis, MN, USA; [c]Hennepin Healthcare/Minnesota Poison Control System, Minneapolis, MN, USA

Objectives: Severely intoxicated patients due to alcohol or illicit drugs are sometimes intubated, ventilated, and sedated in an ICU to minimize pulmonary aspiration as drugs metabolize and airway reflexes return. We aim to describe a contemporary cohort of Emergency Department (ED) patients who underwent tracheal intubation due to complications of alcohol poisoning and compare their outcomes to patients intubated for non-alcohol intoxication.

Methods: We studied consecutive patients who underwent tracheal intubation for intoxication in a safety-net hospital ED between 2020 and 2022 as part of a quality improvement project. Patients known to have attempted suicide by overdose were excluded. After each intubation, physicians completed a questionnaire with patient and intubation characteristics; additional data were collected by electronic record review. The primary outcomes were the duration of mechanical ventilation and length of ICU stay. Other outcomes included aspiration pneumonia, defined by lower respiratory tract culture or empiric antibiotic treatment for >3 days, self-extubation, and tracheostomy or artificial nutrition at ICU discharge. Data were summarized using descriptive statistics and variables compared using the Wilcoxon rank sum test or chi square test.

Results: Of 246 intoxicated ED patients who were intubated, 89 patients (36%) had alcohol poisoning (median age 32 years, interquartile range [IQR] 25–45) with a median ethanol level of 0.26 g/dL (IQR 0.21–0.37, range 0.07–0.62), median interval from ED arrival to intubation of 20 min (IQR 11–44), and 97% first attempt intubation success. Intubation indications among patients with alcohol poisoning were failure of airway protection (96%), hypoventilation (3%), and shock (1%). Approximately one-half of alcohol poisoned patients (51%) had a Glasgow Coma Scale score <8, 24% were vomiting, and 43% had fluid pooling at the glottis during laryngoscopy. Among the 157 non-alcohol intoxicated patients, the median age was 34 years (IQR 29–44), the suspected intoxicants included methamphetamine (36%), heroin (26%), other opioid (26%), or cocaine (9%), and the median ethanol level was 0 g/dL (IQR 0–0.04). The group with alcohol poisoning, as compared to those with other intoxication, had fewer hours of mechanical ventilation (median 14 vs. 24 h, $p < 0.001$) and hours in the ICU (19 vs. 35 h, $p < 0.001$). A similar proportion of patients self-extubated in the alcohol poisoning (11%) and other intoxication (8%) groups ($p = 0.34$), and 3 of 22 patients required re-intubation after self-extubation. Aspiration pneumonia was diagnosed more frequently in alcohol poisoned vs. other intoxicated patients (21% vs. 33%, $p = 0.05$). No patients with alcohol poisoning had a serious intubation complication or required artificial ventilation or nutrition at ICU discharge. In the other intoxication group, one patient survived peri-intubation cardiac arrest, five patients (3%) received tracheostomy, and 10 patients (6%) received artificial nutrition at ICU discharge.
Conclusions: As compared to ED patients with acute intoxication from substances other than alcohol, patients intubated with alcohol poisoning had a shorter median ICU length of stay (19 h) and used relatively few ICU resources.

KEYWORDS Alcohol poisoning; intoxication; resource utilization

gerva051@umn.edu

203. Fentanyl and fentanyl analogue exposure among emergency personnel and first responders: a systematic review

Axel Adams[a], Caitlin Maloy[a], Matthew Valento[a] and Brandon Warrick[b]

[a]University of Washington, Seattle, WA, USA; [b]University of New Mexico, Albuquerque, NM, USA

Background: The opioid epidemic continues to deepen and is increasingly dominated by fentanyl and fentanyl analogues. This may put first responders at risk of exposure to fentanyl analogues via possible dermal, inhalation, and ingestion routes, with many cases of first responder exposure often described in the news media. The American College of Medical Toxicology has provided guidelines on best practices for first responders, stating that likelihood of clinically significant intoxication is low, but that basic personal protection equipment (PPE) safeguards such as using respirators, eye protection, long sleeves, and gloves are indicated; however, no systematic review on exposures documented in the literature has been performed. We aim to perform a systematic review of the literature to describe occupational illnesses from fentanyl and its analogues.
Methods: We conducted a systematic review of the literature following the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, to assess the danger that occupational exposure to fentanyl poses for first responders. Articles with an English translation that were published through May 2020 were considered. PubMed, EMBASE, Scopus, Web of Science, CINAHL, and NIOSH were searched using a combination of controlled vocabulary terms and keywords with Boolean operators. Lay reports and consensus statements were excluded. Two independent, blinded reviewers screened articles, and abstracted data on route of exposure, PPE used, analytic confirmation, and medical outcome. This review is registered with the Prospero Database (Prospero ID CRD42020194176).
Results: The search study yielded 283 citations. All identified studies were observational studies. First responders included police officers, fire fighters, EMTs, autopsy technicians, and forensic laboratory technicians. Ten of the 12 were NIOSH HHE reports. Comprehensive drug testing in exposed first responders was rare; but in the assessment of forensic laboratory workers, exposure to fentanyl with detectable levels in biological samples was commonly observed. Among first responders possibly exposed to fentanyl or fentanyl analogues, none were admitted to the hospital and only four received naloxone; however, all four officers had improvement of subjective symptoms after naloxone administration. Of those who received naloxone, all four cases lacked some degree of PPE (two lacking respirators, one gloves, and one with short sleeves). Amongst all exposures, partial PPE use was common – with less than 10% of fire-EMS providers using respirators and eye protection in one survey, with only 1% wearing wrist or forearm protection. There were no cases of severe respiratory depression requiring assisted ventilation or hospital admission.
Conclusions: Clinically significant occupational exposure to fentanyl amongst first responders is extremely rare. In this systematic review of available literature, there are no cases of severe intoxication and no cases of permanent complication or disability. Naloxone was infrequently used. Of those exposed, few had analytic confirmation of fentanyl. Evidence from forensic laboratory technicians suggests that first responders may experience subclinical exposure to fentanyl and fentanyl analogues when inadequate PPE is used. While clinical intoxication was rare, first responders should still employ basic PPE to minimize fentanyl exposure risk.

KEYWORDS Fentanyl; first responder; opioid

axeadams@uw.edu

204. Suicide attempts in adolescents and young adults reported to a state's two poison control centers: examining possible risk factors and precipitating events one year after the COVID-19 pandemic

Mark Su[a], Maria Mercurio-Zappala[b], Lauren Schwartz[b], Jeanna Marraffa[c], Christine Stork[c], Jessica Smith[c] and Charles DiMaggio[d]

[a]New York City Poison Control Center, Manhasset, NY, USA; [b]New York City Poison Control Center, New York, NY, USA; [c]Upstate NY Poison Center, Upstate Medical University, Syracuse, NY, USA; [d]New York University Grossman School of Medicine, New York, NY, USA

Background: A national study of calls to US Poison Control Centers (PCCs) between 2000 and 2018 reported more than 1 million cases of suicide attempts by self-poisoning in those ages 10–25 years. The majority of these cases were female and did not result in death. The rationale and motive for this increase is unclear. Our state PCCs conducted this prospective, observational study in order to gain a greater understanding of the

contributing factors to suicide attempts among adolescents and young adults after the COVID-19 pandemic began.
Methods: This was a prospective observational study of all calls coded as "intentional overdose – suspected suicide" in individuals between the ages of 10–24 from January 1, 2021–December 31, 2021. Patient demographics, exposure and caller sites, top five substances involved, management site, and medical outcome were extracted; additional information was assessed and included: number of previous suicide attempts at self-harm and method of previous suicide attempt; if applicable, transgender identity, precipitating event(s), the "impulsiveness" of ingestion, and previous reported COVID-19 diagnosis. Deidentified data were entered into REDCap. The data were analyzed using descriptive statistics.
Results: During the one-year study period, we identified 4952 cases of "intentional overdose – suspected" in patients between 10 and 24-years-old. The cases were equally distributed between the centers. The mean age of the patients was 17years (SD ±3.36 years). With respect to "sex assigned at birth," 3869 (78.1%) were classified as "female," 1065 (21.5%) were classified as "male" and 18 (0.4%) were "unknown." In addition, 78 (1.6%) of the patients identified as "transgender." The "exposure site" for 4810 (97.1%) subjects was "own residence;" the "caller site" for 4353 (87.9%) subjects was a "healthcare facility." The top five substances reported in total included adult acetaminophen (973), ibuprofen (853), atypical antipsychotics (424), sertraline (325), and fluoxetine (303). Of patients with previous documented COVID-19 infection, 57/4947 (1.2%) cases had a history of testing positive for COVID-19. With respect to potential precipitating events, 1006/4952 (20%) patients had a possible precipitating event identified; the three most commonly identified precipitating events included "mental health" (40.8%); "relationship issues" (20.9%); and "domestic issues" (11.0%). There were 858/2952 (17%) cases with documented previous suicide attempts; of these, 240 (28%) attempts were made with "medications," 410 (47.8%) attempts were with "unknown" means, 208 (24.2%) attempted suicide by a "violent" method. There were 176/4952 (3.6%) cases with "major effects" and 3/4952 (0.06%) "deaths" in this cohort.
Conclusions: Suicide attempts in adolescent and young adults were commonly reported to this state's PCCs over the one-year study period. Female sex remains a risk factor but few cases were associated with a previous COVID-19 infection. Precipitating events were identified in 20% of cases; the majority of cases were associated with good outcomes. Further analysis of suicide attempt risk factors are necessary in this population to determine where to focus public health interventions.

KEYWORDS Suicide; COVID-19; adolescent

su.mark.k@gmail.com

205. Hemodialysis enhances elimination of ethosuximide in massive overdose

Lauren Wells[a], Matthew Stanton[a], David Gummin[a], Michael Brooks[b] and Ryan Feldman[a]

[a]Froedtert and the Medical College of Wisconsin, Milwaukee, WI, USA; [b]Advocate Aurora Health, Sheboygan, WI, USA

Background: Ethosuximide (ESM) is an antiepileptic used for the treatment of absence seizures presumably because it partially inhibits T-type calcium channels. In the setting of overdose, it may cause significant and prolonged sedation, though reports of massive overdose are scarce. This case describes the clinical course and pharmacokinetic changes after ethosuximide overdose treated with intermittent hemodialysis (iHD).

Case report: A 41-year-old female with a past medical history of anxiety and depression presented to the emergency department after being found unresponsive at home following a self-harm attempt. It was believed that she ingested an unknown amount of her daughter's ESM. Emergency medical services intubated the patient and transported her to an emergency department. Initial vital signs and labs were heart rate 108 beats per minute, blood pressure 119/56 mmHg, temperature 92.8 degrees F, potassium 2.4 mEq/L, anion gap 18 mEq/L, lactate 6.8 mmoL/L, ethanol 240 mg/dL, and an arterial pH 7.2. An immunoassay urine drug screen was positive for benzodiazepines. No other vital signs or laboratory assays were abnormal. A head CT and MRI were obtained, both without acute intracranial findings. An initial ESM level was sent and was later quantified at >450 mg/dL. There was concern for seizure-like activity with intermittent jaw rigidity during admission days 1–2; however, intermittent electroencephalogram was negative for epileptiform activity. The patient remained obtunded with minimal response and only non-purposeful movements during days 1–10 despite multiple sedation holidays, and the patient's family considered withdrawing care. Her course was complicated by a methicillin-susceptible Staphylococcus aureus pneumonia and bacteremia treated with antibiotics. On day 7, iHD was recommended. The patient received 3 sessions over the next 4 days, and serial serum ESM concentrations were obtained. By day 11 the patient was extubated and demonstrated spontaneous movements. Over the next 4 days she steadily improved until day 15 where she was alert and following commands, and she was discharged neurologically intact on day 18.
Discussion: With a volume of distribution of 0.7 L/kg, protein binding of 21.8%, and a molecular weight of 141 daltons, ESM appears to be a good candidate agent for iHD. A single case series in patients with chronic renal disease who underwent iHD after one therapeutic dose of ESM showed a reduction in half-life by 38.8–52.4%. An extensive literature search did not reveal previous reports of the use of iHD in the setting of ESM overdose. In this case, the apparent elimination half-life of ESM was reduced from 40 h to 16 h (60%) by iHD.
Conclusions: iHD is a reasonable treatment modality in the setting of ESM toxicity, particularly when complicated by prolonged sedation.

KEYWORDS Ethosuximide; hemodialysis; overdose

laurenehwells@gmail.com

206. Pediatric toxicology patients and appropriateness of initial disposition

Lynne Rosenberg[a], Riku Moriguchi[b], Nikolaus Matsler[c] and Laurie Halmo[a]

[a]University of Colorado School of Medicine, Aurora, CO, USA; [b]Denver Health and Hospital Authority, Denver, CO, USA; [c]Rocky Mountain Poison and Drug Safety, Denver, CO, USA

Background: Approximately 14% of toxic exposures reported to poison centers in the US are admitted to a critical care unit, representing over 80,000 patients in 2020. Recent studies suggest that many pediatric toxicology patients may not actually require critical care interventions despite being admitted to a critical care unit, resulting in thousands of dollars of excess cost per patient. Given these findings, we sought to determine the proportion of pediatric toxicology patients admitted to the Pediatric Intensive Care Unit (PICU) at our institution as a preliminary step in a quality improvement project designed to improve the proportion of pediatric toxicology patients admitted to the appropriate level of care.

Methods: We conducted a preliminary study at a single, free-standing tertiary care children's hospital to determine the proportion of pediatric toxicology patients admitted to the appropriate level of care and better characterize those patients who were inappropriately admitted to the PICU. Pediatric toxicology patients were defined as those evaluated by the medical toxicology consultation service. Disposition to a critical care setting was deemed "appropriate" if the patient received at least one critical intervention. Critical interventions were defined as interventions our hospital typically does not perform outside of a critical care setting. Trained data abstractors reviewed the medical records of all toxicology patients admitted to our institution between January 1, 2021 and December 31, 2021. Patient demographics, admission characteristics, and critical interventions performed were collected. Descriptive statistics were used to summarize the data. Our hospital's quality improvement oversight committee reviewed this project and deemed it non-human subjects research, thus exempting it from IRB review.
Results: There were 204 pediatric toxicology patients admitted to our hospital during the study period with a mean age of 11.6 years (SD 5.8 years), 67.2% of whom were female. One hundred and nine ($n = 109$, 53.4%) were initially admitted to the PICU. Eighty nine ($n = 89$, 81.7%) of those initially admitted to the PICU were transferred to the floor or discharged directly from the PICU within 1 day of admission. A total of one hundred and fifteen ($n = 115$, 56.4%) required PICU care at some point. Of those 115 patients admitted to the PICU, fifty eight ($n = 58$, 50.4%) did not receive any critical interventions during their stay. Of those admitted to the PICU with no critical interventions performed, thirty two ($n = 32$, 55.2%) were admitted via our hospital's emergency department or satellite sites affiliated with our institution while twenty five ($n = 25$, 43.1%) were directly admitted from an outside facility. Only six ($n = 6$, 6.3%) of those patients initially admitted to the floor required escalation to the PICU.
Conclusions: Over half of pediatric toxicology patients admitted to our tertiary care children's hospital were admitted to the PICU, the majority of whom did not require critical care interventions. Of those patients admitted to the PICU who did not require critical care interventions, more were admitted via our own institution's emergency departments than from outside facilities, suggesting a promising target for a hospital-wide quality improvement intervention designed to improve the appropriateness of initial disposition for pediatric toxicology patients.

KEYWORDS Pediatric; intensive care; disposition

lynne.rosenberg@cuanschutz.edu

207. The evolution of frequently asked questions during the COVID-19 global pandemic

Stefan Weekes, Charles Overton, Tejas Shah and Justin Arnold

Florida Poison Information Center – Tampa, Tampa, FL, USA

Background: Throughout the COVID-19 pandemic in the US, the general public and healthcare professionals searched for information related to this new pathogen called SARS-CoV-2. In conjunction with health departments, Poison Centers played a crucial role in many states in providing healthcare information to the general public and healthcare providers. Given the lack of information on SARS-CoV-2 at the beginning of the outbreak, our Poison Center utilized a list of frequently asked questions and standard answers developed by the State Department of Health and the Poison Center Network. The primary objective of this study is to explore the expansion of the frequently asked questions manual that our COVID-19 Information Hotline personnel utilized to address the general questions over 16 months, dating from March 2020 to June 2021.
Methods: Researchers collected all updates from the "Frequently Asked Questions Manual" from March 2020 to June 2021. The frequently asked questions (FAQs) list evolved through revisions and addendums throughout the lifespan of the COVID-19 Information Hotline. An analysis of the FAQs identified trends of public interest was performed through a relational database querying to identify unique, duplicate, and modified records of questions. Investigators collected several data points regarding "Frequently Asked Questions" through interpretation of frequency, retention of questions asked, and chronological sequence regarding questions. Evaluating these data points led to interpreting which questions were most relevant for the line's duration.
Results: The original FAQ manual for the COVID-19 Information Hotline began with 76 questions and expanded to 162 questions by the final document. Furthermore, health professionals on the hotline who were PharmD, RN, DO, and MDs were able to provide information on an additional 44 specialized questions, bringing the total FAQs to 206. A relational database that queried unique, duplicate, and modified records of questions yielded 346 unique questions. Of the 346 questions, 47 were not modified after they were first introduced. In order to evaluate the FAQs progression, the changing scripts were combined into monthly groupings. The largest categories of FAQs during the COVID hotline duration included questions on travel and vaccines. Researchers found 27 FAQs related to travel and 41 FAQs related to vaccines. These categories of FAQs were updated as new guidelines and legislation were enacted.
Conclusions: Researchers assessed the Poison Center's FAQ list through a retrospective relational database model. Identifying the most relevant and evolving questions can aid Poison Centers in focusing on the most critical questions for callers seeking answers during COVID-19 and in future pandemics.

KEYWORDS COVID; FAQ; public health

Sweekes@tgh.org

208. Hypoglycemia following recreational drug use

George Warpinski[a] and Meghan Spyres[b]

[a]Banner University Medical Center – Phoenix, Phoenix, AZ, USA; [b]University of Arizona College of Medicine, Phoenix, AZ, USA

Background: Cases of sulfonylurea contamination in street drugs have been reported, but to our knowledge there are no case reports of sulfonylurea contaminating methamphetamine or fentanyl.
Case report: A 37-year-old man was found unresponsive and hypoglycemic by EMS. He was given 2mg naloxone in the field with no effect. Point of care blood glucose read "low," and one amp of D50 was administered with some improvement in the patient's level of consciousness. In the ED he was sleepy but would awaken to voice. He demonstrated confused speech and did not follow commands. While in the ED the patient had recurrent episodes of hypoglycemia as low as <20 ng/dL only transiently responsive to D50 boluses. He was placed on a dextrose infusion that was titrated up from 5% to 10% at 100 mL/h due to recurrent hypoglycemia and was given an octreotide bolus of 50 mcg SQ. Despite octreotide and glucose infusion the patient had recurrent episodes of hypoglycemia during his admission. Approximately 16 h after his presentation, the patient was alert and oriented and able to tolerate PO. He was fed a regular diet and glucose infusions were held without recurrence in hypoglycemia. The patient reported using multiple different drugs

including marijuana, fentanyl, and methamphetamine but specifically denied any history of diabetes, use of diabetic medications, or attempts at self-harm. Infectious work up was unremarkable; UDS was positive for amphetamine, THC and fentanyl and GC/MS testing was positive for methamphetamine, amphetamine, nicotine, cotinine, caffeine, and theobromine. Sulfonylurea screen resulted positive for glimepiride.
Discussion: This is a case report detailing the clinical effects of a suspected contaminant in a recreational drug. In this case, we suspect that the patient's methamphetamine or fentanyl was contaminated with glimepiride. In our patient population, most fentanyl is ingested in the form of illicit blue "M30" pills. Glimepiride is occasionally produced in the form of a round blue pill.
Conclusions: Sulfonylurea adulteration of illicit drugs occurs and can result in recurrent and refractory hypoglycemia; glimepiride may in some cases mimic illicit M30 fentanyl pills.

KEYWORDS Fentanyl; sulfonylurea; hypoglycemia

gwarpinski@gmail.com

209. Massive acetaminophen ingestions treated with renal replacement therapy: a case series from a regional poison center

Ryan Fuchs[a], Travis Olives[b,c], Samantha Lee[c], Brian Driver[b] and Jon Cole[b,c]

[a]Hennepin County Medical Center, Minneapolis, MN, USA; [b]Department of Emergency Medicine, Hennepin Healthcare, Minneapolis, MN, USA; [c]Minnesota Poison Control System, Minneapolis, MN, USA

Background: Acetaminophen (APAP) poisoning, despite the effective antidote N-acetylcysteine (NAC), continues to be a leading cause of drug-induced liver failure and among the highest single substance fatalities in the US, accounting for 16.7% of fatalities in 2020. Progression to hepatotoxicity or death rarely still occurs despite timely initiation of NAC, typically in the setting of massive ingestions. Criteria have been proposed for extracorporeal removal of APAP in massive ingestions, yet, outcomes data following such measures are generally limited to single case reports. We describe a case series of massive acetaminophen ingestions who underwent hemodialysis for APAP removal over a 20-year span reported to a regional poison center.
Methods: This was a retrospective study of a single regional poison center (PC) database from 2000 to 2022. Inclusion criteria were cases of acute, acute on chronic or unknown APAP poisoning, who underwent renal replacement therapy (RRT). Cases were identified by querying our electronic database (Toxicall®) for any exposure case with a product code that included APAP where "hemodialysis" was coded as "performed." Cases were excluded if peak serum APAP concentration was <500 mcg/mL, or if RRT was utilized for any other reason than for (1) purposes of removing APAP or (2) empiric treatment of severe acidosis in context of APAP >500 mcg/mL. We report call information, clinical effects, therapies, and outcomes as defined in the National Poison Data System. Additional outcome measures obtained from PC case note review included time to initiation of RRT, time to development of acidosis, quantitative laboratory measures of acidosis and APAP concentration before and after RRT. Descriptive statistics were employed.
Results: A total of 225 cases returned on initial data query. After applying exclusion criteria, a total of 12 cases remained for final inclusion. Mean age was 44 years, 50% were male. Co-ingestions occurred in 75% of cases, including 63% with an anticholinergic or opioid medication. Mean presenting laboratory studies were notable for pH 7.13, pCO_2 28.7 torr, bicarbonate 10.5 mEq/L, Lactate 12.4 mmol/L. Patients most commonly presented with significant altered mentation, often requiring intubation prehospital or on ED arrival. Ingestion time was unknown in the majority of cases. Mean APAP level was 794 mcg/mL. Two patients demonstrated signs of hepatotoxicity on initial presentation. NAC was administered in all cases with varying regimens. Most cases used the Prescott protocol; however, cases occurring after 2015 generally doubled the infusion rates of the final maintenance bag (12.5 mg/kg/h). RRT was performed in all cases with two patients undergoing CRRT due to hemodynamic instability. Among cases reported, the average time of dialysis was 5.5 h. Mean time from presentation to initiation of RRT was 15.9 h. Time to initiation of dialysis greater than 12 h was associated with increased mortality ($p = 0.0182$). It was also noted most cases with shortened time to RRT also occurred following 2015 when the increased NAC dosing was observed. Hepatotoxicity occurred in 55% of patients. No patients underwent liver transplant.
Conclusions: Among twelve patients undergoing RRT for APAP poisoning, time to dialysis >12 h was associated with increased mortality. Intermittent hemodialysis was the most common RRT modality, and hepatotoxicity was not inevitable.

KEYWORDS Acetaminophen; hemodialysis; poison center

ryan.fuchs@hcmed.org

210. The tiny tox talk; an innovative approach for learning, teaching, and review

Sean Bryant

Toxikon Consortium, Chicago, IL, USA

Background: Our medical toxicology fellowship sponsors a large rotation consisting of resident, medical student, and pharmacy student/resident rotators each month. Education provided to the rotators primarily occurs through discussion of poison center cases, chalk talks on basic exposures and management strategies, and journal club presentations each week. While residents take primary call and manage poison center cases, medical student education is sometimes deficient. The objective of this abstract is to share an innovative mechanism to include medical student participation within a toxicology rotation.
Methods: Medical student rotators are welcomed each month with specific directives pertaining to their "tiny tox talk." The objectives of the activity include learning about a topic in medical toxicology that corresponds to the current fellow reading assignment from the core content of medical toxicology. The students are sometimes provided an article pertaining to their topic and commonly utilize primary medical toxicology text books for reference. The students are directed to make one creative PowerPoint slide and prepare to teach on the topic for 3–5 min.
Results: Medical students, fellows, and faculty all have goals during this weekly activity. Students learn something new and practice being concise as educators. Many struggle following directions (i.e., keeping their talk to less than 5 min and utilizing only one slide). This activity stresses the importance of being creative with their graphic and meaningful and specific with their presentation. Fellows are given the opportunity to reinforce topics and concepts from the core content that they may end up being tested on for board certification. Faculty who organizes the activity and makes assignments do so strategically in order to cover high yield fellow level material. When possible, a student is assigned a topic that corresponds with the medical specialty they will pursue in residency training. Examples include, a

pediatric bound student was assigned to cover benzyl alcohol poisoning and "gasping syndrome" in NICU patients reported in NEJM, 1982, an ophthalmology bound student discussed ocular pathology from a tarantula urticating hair, and an orthopedic bound student presented tendinopathy pathophysiology from fluoroquinolone antibiotics.
Conclusions: Medical student engagement, inclusion, and education can be overshadowed during robust toxicology rotations centered around resident activity. Assigning students strategic topics to discuss provides a means for learning, teaching, and fellow review. This educational method deserves thoughtful further study in order to use our platform to effectively train the clinical educators of tomorrow and comprehensively prepare our fellow trainees for board certification.

KEYWORDS Education; toxicology Rotation; medical student

toxiholic@gmail.com

211. Review of recommendations for the use of renal replacement therapy (RRT) in poisoned patients

Amanda Hammond[a], Stephanie Hon[b], Patrick Filkins[a] and Robert Geller[a]

[a]Georgia Poison Center/Atlanta, GA, Atlanta, GA, USA; [b]Georgia Poison Center/Grady Health System, Atlanta, GA, USA

Background: Considering the lack of specific antidotal therapy for many toxicities, use of enhanced elimination can become an important consideration. For ingestions of toxic alcohols, salicylates, lithium, acetaminophen and valproic acid, appropriate and timely initiation of Renal Replacement Therapy (RRT) can have a substantial impact on morbidity and mortality. Still, with the risks and limitations of this procedure, the recommendation for RRT from a poison center may not always be accepted. Case reports and analysis of poisoning data show that underutilization of RRT treatments in some of the above toxicities may serve as a preventable cause of death. The objective of this review was to describe how RRT is currently recommended and assess whether acceptance or rejection of those recommendations affected patient outcomes and length of stay.
Methods: Multiple reviewers performed a retrospective chart review that recorded demographic, administrative, and clinical data from all patients greater than 12 months, with a history of ingestion of toxic alcohols, salicylates, lithium, acetaminophen and/or valproic acid where RRT was recommended, performed, or both as reported to one poison center during a set 5-year period. Any case that did not fit the above criteria, involved non-ingestion related need for RRT, or involved unrecorded patient outcomes were excluded. Data were analyzed using a Kruskal-Wallis Test appropriate for three independent groups of ordinal data as well as Chi-square analysis for demographic data.
Results: A poison center data query was performed for all cases from January 01, 2016 to December 31, 2021, for which any type of RRT was recommended, performed, or both. 705 charts were evaluated for inclusion. 447 cases were excluded; 342 for not meeting inclusion criteria, 31 cases received RRT for reasons other than the ingestion, and 74 had no documentation of medical outcome. 258 patients were included and split into three groups; Group One ($n = 98$) where RRT was not recommended and was performed, Group Two ($n = 27$) for which RRT was recommended and was not performed, and Group Three ($n = 133$) for which RRT was recommended and was performed. The groups showed no statistically significant differences in demographics, except for age. Group 1 was on average 7–8 years younger than patients in the other two groups. Main outcomes evaluated were length of stay and poison center outcome codes. Both showed statistically significant results at a p-value of 0.05. Group One had an average admission length of 7.2 days, Group Two 4.3 days, and Group Three 5.9 days. Groups One and Two were significantly more likely to result in an outcome categorized as major, while patients in Group Three were more likely to result in an outcome categorized as moderate.
Conclusions: This study found that patients who received RRT for the included ingestions without the recommendation of a poison center had a length of stay 1.2 days longer and worse outcomes than cases where a poison center provided the recommendation for RRT. This suggests that, for the ingestions studied, consultation with a poison center may result in shorter hospital stay and patient benefit. Sub-group analysis or continued research could be done to evaluate the effect of more specific consultation details (e.g., response time to recommendation, documentation of indication) on those same outcomes.

KEYWORDS RRT; dialysis; poison center

AOTEROROMANO@GMAIL.COM

212. Retrospective review of 22 years of Carolina jessamine (*Gelsemium sempervirens*) plant exposures reported to one poison center

Michael Beuhler and Patricia Beuhler

North Carolina Poison Control, Charlotte, NC, USA

Background: Carolina jessamine is a flowering vine commonly found throughout the southern central and eastern US. It contains highly toxic alkaloids including gelsemine, a potent glycine agonist neurotoxin that has caused significant illness. As this plant is similar in appearance to the very commonly foraged honeysuckle plant, exposures due to misidentification are not infrequent.
Methods: Retrospective review of Carolina jessamine ingestion exposure cases followed to a known outcome from January 1, 2000 to April 20, 2022 reported to one US Poison Center. All case records were reviewed with free text notes taking precedence over coded fields. Case demographics, management site, observation time, signs/symptoms, type of exposure (nectar, flower, leaf, twig/vine), and if there was any preparatory heating were abstracted. Case outcomes were abstracted with no effect/minor outcomes and moderate/major outcomes grouped for analysis. Cases were excluded if it was not an oral exposure to Carolina jessamine or the exposure site was out-of-state.
Results: Of 97 cases reviewed, 5 were excluded, leaving 92 cases. The majority were pediatric cases ($n = 81$) with an average age of 6.6 years; there were 55 cases between the age of 6 and 17. The youngest patients (age <6) were exposed to the nectar (35%), flower (42%), leaves (19%) and twig/vines (4%); whereas the 6- to 17-year-olds were exposed to the nectar (71%), flower (24%) and twig/vine (5%). Patients were observed for a median time of 4 h [IQR 3–6.1]. Most cases (65%) were managed outside of a health care facility (HCF). The most frequent signs/symptoms were: dizziness/vertigo 9%, fatigue 8%, nausea 5%, muscle weakness 4%, blurred vision 3%, headache 3%, vomiting 2%, and abdominal pain 2%. The following symptoms were reported only 1% of the time: agitation, chest discomfort, confusion, hallucinations, miosis, paresthesias, respiratory failure and slurred speech. Outcomes were No effect 82%, Minor 14%, Moderate 3% and Major 1%. For patients age <6, 100% had an outcome of No Effect. All cases where heat was involved in preparation ($n = 8$) developed symptoms and included the one major adult outcome case that required intubation for respiratory failure; the difference in outcome was significant ($p = 0.002$). Adults were more likely to have worse outcome ($p = 0.005$), however they were underrepresented in the data (12%). The one adult patient that blended up

flowers to make a drink without heating it only suffered minor symptoms.
Conclusions: This is the largest reported series of Carolina jessamine ingestions. This exposure appears to differ from other pediatric "exploratory" plant exposures in that more cases occur in children beyond the typical exploratory age of <6 years. Patients at risk for developing symptoms potentially may be those who heat the plant when preparing it, although a larger dose in these cases cannot be ruled out. Clinical toxicity in children appears rare from Carolina jessamine and these exposures can likely be managed without HCF referral.

KEYWORDS Gelsemine; pediatric; plant poisoning

m_beuhler@yahoo.com

213. State legalization of recreational marijuana results in increased pediatric exposures

Maureen Roland, Bryan Kuhn and Kim Schmid
Banner Poison and Drug Information Center, Phoenix, AZ, USA

Background: Beginning in 1996 with California, several states have moved to legalize medical and recreational cannabis. Our state joined other states by legalizing medical cannabis in 2010 and recreational in 2020. With the expanded availability of cannabis products, poison centers across the country have seen increases in unintentional cannabis exposures in the pediatric population. We sought to describe our poison center's experience with the incidence of pediatric cannabis exposures over a five-year period, spanning a timeframe before and after legalization of recreational cannabis.
Methods: A 5-year retrospective review of pediatric cannabis exposures from a single poison center was completed. Inclusion criteria were all patients <6 years of age with unintentional cannabis exposure.
Results: Over the 5-year period of our study, our state saw a steady increase in the incidence of unintentional pediatric cannabis exposures. Increases were most notable in 2018–2019 (52%) and 2020–2021 (74%). The largest increase in incidence correlates with the states legalization of recreational cannabis.
Conclusions: The legalization of recreational marijuana cannabis in a state resulted in a significant increase in pediatric (<6 years of age) exposures reported to a single regional poison center. States have a responsibility to create safe marijuana practices, including product packaging and parent education. Poison centers play a vital role in providing evidence-based practices to ensure the safety of all in the community.

KEYWORDS Cannabis; pediatrics; education

Maureen.Roland@Bannerhealth.com

214. Severe aconitine toxicity from monkshood purchased online

David Fowler[a], Fiona Garlich[b] and Erik Swanson[a]
[a]LAC + USC Medical Center, Los Angeles, CA, USA; [b]University of Southern California, Los Angeles, CA, USA

Background: Aconitine is a norditerpinoid alkaloid found in *Aconitum species* that acts primarily by persistent activation of voltage-gated sodium channels. Acute poisoning results in potentially fatal neuro- and cardiotoxicity, with paresthesias, weakness, diverse ventricular tachydysrhythmias, and cardiac arrest. *Acontinum* root derivatives are used therapeutically in Chinese herbal medicine, and represent a major source of poisoning. Various *Aconitum species*, known as monkshood or wolfsbane, are also grown widely in the US as ornamental garden plants. We present a case of severe aconitine toxicity from intentional ingestion of monkshood bulb and seeds purchased over the internet.
Case report: A 28-year-old male with no prior medical history presented to the Emergency Department (ED) via ambulance after ingesting one and a half monkshood bulbs and an unknown quantity of *aconitum carmichaelii* (Chinese monkshood) seeds in a suicide attempt. He is believed to have purchased the seeds and plant from an online garden seed supplier. Several days prior he had attempted suicide by ingesting *Taxus cuspidata* (Japanese yew) and *Thevetia peruviana* (yellow oleander) seeds that he had similarly obtained online. On ED arrival he was hypotensive, minimally responsive, and actively vomiting. Initial vitals included HR 121/min, BP 69/31 mmHg, and RR 30/min. The initial ECG showed an accelerated junctional rhythm with QRS and QTc measurements of 88 and 526 ms respectively. Several minutes later he developed frequent multifocal premature ventricular contractions and QTc prolonged to 578 ms. In addition to intravenous fluids, vasopressors, and rapid sequence intubation, he was given boluses of sodium bicarbonate and magnesium sulfate without improvement. Following consultation with the Toxicology service he was given amiodarone 150 mg iv push, with rapid improvement in dysrhythmias and hemodynamic status. He was started on a continuous amiodarone infusion and given an additional dose of magnesium sulfate for a persistently prolonged QTc. Laboratory workup was notable for a serum digoxin level of 0.3 ng/mL, negative acetaminophen and salicylate levels, and negative urine drug screen. On hospital day 2, amiodarone and vasopressors were stopped, and the patient was transferred to an outside facility in stable condition.
Discussion: In this case, large ingestion of both *Aconitum* seeds and bulbs resulted in severe cardiotoxicity responsive to amiodarone. Most reported cases of aconitine poisoning result from unintentional misuse or intentional ingestion of traditional Chinese herbal preparations, with some documented exposures to plant material through foraging. To our knowledge, intentional self-poisoning by *Aconitum* seeds obtained online has not been previously reported. Queries on several search engines result with innumerous sites from which monkshood and other toxic plants and seeds can be purchased without any legal safeguards.
Conclusions: In this case, we report severe, life-threatening aconitine toxicity from monkshood seeds purchased over the internet, highlighting the ease with which these highly toxic and legal substances can be obtained.

KEYWORDS Aconitine; monkshood; online

dfowler@dhs.lacounty.gov

215. Cannabis ingestions by dogs reported to poison centers

Kelly Hogue[a] and Mathias Forrester[b]
[a]North Texas Poison Center, Midlothian, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Ingestion of cannabis by dogs may result in serious adverse effects. Studies have suggested dog cannabis poisonings are increasing, possibly because of an increase in the popularity or availability of cannabis due to the legalization of the medicinal or recreational use of cannabis in various states. The increase in dog cannabis poisonings may also be due to an increase in tetrahydrocannabinol (THC) concentration in cannabis products. The objective of this study was to characterize cannabis ingestions by dogs reported to poison centers that primarily manage human exposures.

Methods: Cases were cannabis exposures (Generic codes 0083000, 0200618, 0310033, 0310034, 0310035, 0310036, 0310096, 0310097, 0310121, 0310122, 0310123, 0310124, 0310125, 0310126) reported to a large, statewide poison center network during 2000–2020 where the exposure route was ingestion, the patient species was animal, and the animal type was dog. The distribution of cases was determined for various factors.
Results: A total of 142 cannabis ingestions by dogs were identified. There were 28 (19.7%) ingestions during December–February, 36 (25.4%) during March–May, 43 (30.3%) during June-August, and 35 (24.6%) during September–November. The ingestion occurred at the home of the dog's owner or caregiver in 101 (71.1%) cases, 14 (9.9%) at another residence, 4 (2.8%) public area, and 23 (16.2%) at an unknown location. The management site was 75 (52.8%) on site (outside of a healthcare facility), 62 (43.7%) at a healthcare facility or other location (probably a veterinarian facility), and 5 (3.5%) at an unknown location. The most commonly reported clinical effects were ataxia ($n = 26$, 18.3%), drowsiness/lethargy ($n = 18$, 12.7%), and vomiting ($n = 14$, 9.9%). The ingestion was not serious (no effect, minor effect, moderate effect, not followed-judged nontoxic, not followed-minimal effects possible) in 61 (43.0%) cases, serious (moderate effect, major effect, unable to follow-potentially toxic) in 80 (56.3%), and unrelated to the ingestion in 1 (0.7%); there were no deaths, but the poison center network generally does not follow animal exposures to determine final outcome.
Conclusions: The highest proportion of cannabis ingestions by dogs occurred during June–August. Cannabis ingestions by dogs most often occurred at the owner's own home. Most of these ingestions were managed on site. However, 56% of the ingestions were considered to have potentially serious outcomes.

KEYWORDS Cannabis; dogs; ingestion

kelly.hogue@phhs.org

216. Unhazy results from pediatric exposures to selected nicotine products treated at emergency departments

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas Health – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Aside from cigarettes, cigars, and e-cigarettes, additional products contain nicotine, such as chewing tobacco, snuff, snus, nicotine gum, lozenges, and patches. Toxic effects are dose-related; however, nicotine doses as low as 2 mg have been reported to cause severe toxicity in children. Symptoms of mild exposures can include vomiting, hypertension, tachypnea, and pallor, while severe exposures may result in agitation, hypotension, respiratory depression, arrhythmias, and seizures. The objective of this study was to depict pediatric exposures to selected nicotine products managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 representative US hospitals. The NEISS database also includes all poisonings and chemical burns to children under 5 years of age. National estimates are calculated from database records according to the sample weight assigned to each case based on the inverse probability of the hospital's being selected for the NEISS sample. To identify exposures to selected nicotine products of interest (excluding cigarettes, cigars, and e-cigarettes) among patients aged 0–5 years reported during 2000–2020, records with the letter combinations "tobac," "tobbac," "nico," or "snu" in the mentioned narrative, or the code 1909 (cigarettes, cigars, pipes, or tobacco) in any of the product code fields, were reviewed. Those that appeared to be exposures to selected nicotine products of interest were included. (Product code 1909 does not appear to have been used by NEISS after 2008.) The distribution of estimated exposures to selected nicotine products was determined for various factors.
Results: A total of 132 selected nicotine product exposures (87 chewing tobacco/snuff/spit cup, 19 gum, 13 lozenge, 5 patch, 4 pouch, 3 tablet/pill, 1 drop) were identified, resulting in a national estimate of 4599 exposures. There were 1461 (31.8%) estimated exposures during 2000–2006, 997 (21.7%) during 2007–2013, and 2141 (46.6%) during 2014–2020. Patient age distribution was 349 (7.6%) < 1 year, 2.513 (54.6%) 1 year, 914 (19.9%) 2 years, 296 (6.4%) 3 years, 510 (11.1%) 4 years, and 17 (0.4%) 5 years; 2460 (53.5%) of the patients were male and 2139 (46.5%) female. The patient race was 3278 (71.3%) white, 78 (1.7%) American Indialaska Native, 28 (0.6%) black/African American, 239 (5.2%) other, and 974 (21.2%) not stated. The exposure route was 4441 (96.6%) ingestion, 70 (1.5%) aspiration, 67 (1.5%) ocular, and 22 (0.5%) dermal. The location of the exposure was 3091 (67.2%) home, 75 (1.6%) place of recreation or sports, 74 (1.6%) school, and 1360 (29.6%) not recorded. Vomiting was documented in 1044 (22.7%) of the estimated exposures. The estimated patient disposition was 4108 (89.3%) treated or examined and released, 68 (1.5%) treated and transferred to another hospital, 165 (3.6%) treated and admitted for hospitalization, 196 (4.3%) held for observation, and 62 (1.4%) left without being seegainst medical advice.
Conclusions: Estimated pediatric exposures to selected nicotine products treated in EDs most often involved males, aged 1–2 years, the ingestion route, and vomiting. Most patients were treated and released from the ED.

KEYWORDS Nicotine; pediatric; emergency departments

hinojosam4@uthscsa.edu

217. Tanking gasoline inhalation exposures

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas Health – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Gasoline is among the volatile hydrocarbons classified as inhalants. Deliberate inhalation of gasoline vapors causes intoxication due to immediate pulmonary absorption and lipid solubility, which suggests that the brain is rapidly affected. Gasoline sniffing/huffing may result in drowsiness, confusion, and hallucinations. Complications may include respiratory arrest or depression, seizures, coma, cardiac arrhythmias, and sudden death. The purpose of this study was to characterize gasoline inhalation abuse and misuse reported to poison centers.
Methods: Cases were exposures to gasoline (Generic code 0039502) reported to the National Poison Data System (NPDS), a national database containing data from all US poison centers, during 2000–2020 where the exposure route was inhalation, and the exposure reason was intentional abuse and misuse. The distribution of total cases was determined for various factors related

to patient demographics and exposure circumstances. In addition, the distribution of cases not involving other substances was determined for management and outcome.
Results: Of 4203 total cases, 3090 (73.5%) were intentional abuse and 1113 (26.5%) were intentional misuse. The annual number of cases decreased from 370 in 2001 to 97 in 2020. There were 1138 (27.1%) cases in January-April, 1908 (45.4%) in May-August, and 1157 (27.5%) in September-December. The patient age distribution was 47 (1.1%) 0–5 years, 966 (23.0%) 6–12 years, 1991 (47.4%) 13–19 years, 1025 (24.4%) 20 years and older, and 174 (4.1%) unknown age; 3514 (83.6%) of the patients were male, 669 (15.9%) female, and 20 (0.5%) unknown gender. The exposure site was 3494 (83.1%) patient's own residence, 173 (4.1%) other residence, 108 (2.6%) public area, and 428 (10.2%) other and unknown locations. No other substances were reported in 3796 (90.3%) of the cases. Of these 3796 cases, 1575 (41.5%) of the patients were already at or en route to a healthcare facility, 1048 (27.6%) were referred to a healthcare facility by the poison center, 1055 (27.8%) were managed on site, and 118 (3.1%) were managed at other or unknown sites. The medical outcome was 666 (17.5%) no effect, 1198 (31.6%) minor effect, 560 (14.8%) moderate effect, 54 (1.4%) major effect, 27 (0.7%) not followed-judged nontoxic, 633 (16.7%) not followed-minimal clinical effects possible, 579 (15.3%) unable to follow-potentially toxic, and 77 (2.0%) unrelated effect; 2 (0.1%) deaths were reported. A clinical effect was reported in 2629 (69.3%) of the 3796 cases not involving other substances. Most reported clinical effects were drowsiness/lethargy ($n = 556$, 14.6%), dizziness/vertigo ($n = 447$, 11.8%), confusion ($n = 371$, 9.8%), headache ($n = 303$, 8.0%), ataxia ($n = 293$, 7.7%), nausea ($n = 260$, 6.8%), vomiting ($n = 250$, 6.6%), cough/choke ($n = 206$, 5.4%), and syncope ($n = 151$, 4.0%). The most frequently reported treatments were fresh air ($n = 1486$, 39.1%), dilute/irrigate/wash ($n = 676$, 17.8%), oxygen ($n = 405$, 10.7%), and intravenous fluids ($n = 151$, 4.0%).
Conclusions: The annual number of gasoline inhalation abuse and misuse cases declined over time. More than half of the cases were managed at a healthcare facility, and the majority of inhalations involved adolescents and males and did not involve other substances. Most did not have significant outcomes, although two deaths occurred.

KEYWORDS Gasoline; inhalants; hydrocarbons

hinojosam4@uthscsa.edu

218. Expanding yet contained: water-absorbing bead exposures treated in emergency departments

Maria Hinojosa[a], Shawn Varney[b] and Mathias Forrester[c]

[a]South Texas Poison Center, University of Texas Health – San Antonio, San Antonio, TX, USA; [b]University of Texas Health – San Antonio, Helotes, TX, USA; [c]Independent Researcher, Austin, TX, USA

Background: Water-absorbing beads are made from non-toxic superabsorbent polymers that, when exposed to moisture, can expand to several hundred times their original size. They are marketed as craft-home decor, toys, and plant hydration. In addition, the tiny colorful translucent, candy-like appearance is visually appealing to children. Due to their ability to expand, water-absorbing beads may cause complications when ingested or placed in body orifices. Bowel obstruction following ingestion is an uncommon but fatal complication. The objective of this study was to describe water-absorbing bead exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. The NEISS database also includes all poisonings and chemical burns to children less than 5 years of age. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify water-absorbing bead exposures reported during 2000–2020, records with narratives containing (1) the letter combinations "bead" and "water," "H_2O," "exp," "abs," "poly," "gel," or "jel" or (2) various spellings of "Orbeez" were reviewed, and those that appeared to be water-absorbing bead exposures were included in the study. Various factors determined case distribution. Due to the small number of cases, national estimates were not calculated.
Results: Seventy water-absorbing bead exposures were identified: 29 (41.4%) mentioning the bead could expand in fluid, 20 (28.6%) "water bead," 14 (20.0%) "gel bead," 6 (8.6%) intended for plants, and 1 (1.4%) superabsorbent polymer bead. There were 0 (0.0%) exposures during 2000–2009, 16 (22.9%) during 2010–2015, and 54 (77.1%) during 2016–2020. The patient age distribution was 44 (62.9%) 0–5 years, 22 (31.4%) 6–12 years, 3 (4.3%) 13–19 years, and 1 (1.4%) 20+ years; 45 (64.3%) of the patients were male and 25 (35.7%) female. The patient race was 27 (38.6%) white, 7 (10.0%) black/African American, 10 (14.3%) other, and 26 (37.1%) not stated. The exposure route was 37 (52.9%) ingestion, 22 (31.4%) otic, and 11 (15.7%) nasal. The location of the incident was 33 (47.1%) home, 3 (4.3%) schools, 2 (2.9%) other public property, and 32 (45.7%) not recorded. Clinical effects documented in 2 cases each were constipation, cough, and vomiting. Clinical effects documented in 1 case each were abrasion, bowel obstruction, diarrhea, and otic pain. The patient disposition was 62 (88.6%) treated or examined and released, 6 (8.6%) treated and admitted for hospitalization, and 2 (2.9%) held for observation.
Conclusions: Although uncommon, water-absorbing bead exposures treated in EDs increased over time. Most exposures involved males, children less than 5 years old, ingestion route, and occurred at home. Most patients were treated or evaluated and released from the ED. Most patients had minor clinical findings except for one case of bowel obstruction.

KEYWORDS Water absorbing beads; bowel obstruction; superabsorbent polymers

hinojosam4@uthscsa.edu

219. Massive iatrogenic overdose of SSKI (saturated solution of potassium iodide) with minimal toxicity and large negative anion gap

Alexander Sidlak, Alicia Senart and Lorrie Leclair

Inova Fairfax Medical Center, Falls Church, VA, USA

Background: Potassium iodide solution is used therapeutically to thin mucous secretions. There are no prior reports in the literature on overdose of potassium iodine. There are however reports on potassium overdoses and iodine toxicity from other sources. This literature helped inform our treatment of the patient in this case. We hypothesized that early treatment of a potassium iodide overdose with kayexalate may mitigate resultant hyperkalemia.
Case report: A 22-year-old man with a history of cerebral palsy was admitted with a gastric volvulus requiring operative repair. His course was complicated by pneumonia and respiratory failure. To manage mucous secretions, 200 mg potassium iodide

(SSKI®) was given three times a day through his nasogastric tube. During an overnight administration he was accidentally given a total of 300 mL instead of the ordered 0.2 mL leading to a 300 g dose. The dosing error was recognized immediately and NGT was attempted to be aspirated, but no fluid was obtained. He was given 60 g rectal kayexalate and he was transferred to the ICU for close monitoring.
Discussion: This patient developed characteristic electrolyte abnormalities: a chloride level above the detectable range (>140 mmol/L) with a large negative anion gap (−38). Chloride normalized 20 h after ingestion. He was treated with crystalloid infusions, intravenous calcium gluconate, kayexalate, and furosemide. Ingestion led to administration of 45 meq of potassium and 30 g of iodine. The patient's potassium had a mild rise to 5.5 mmol/L, but treatment was initiated early with sodium polystyrene making it unclear if treatment mitigated a rise in serum potassium or if the dose ingested was below the threshold for severe toxicity. No gastrointestinal, cardiac, or thyroid toxicity resulted from iodide.
Conclusions: Despite a 15-fold dosing error and severe electrolyte derangements, no systemic toxicity resulted from this accidental potassium iodide ingestion.

KEYWORDS Potassium iodine; medication overdose; anion gap
alex.sidlak@gmail.com

220. An unintentional overdose on protonitazene: the dangers of benzimidazole opioids

Mason Jackson and Erik Fisher

Prisma Health Upstate/University of South Carolina School of Medicine Greenville, Greenville, SC, USA

Background: The opioid epidemic sweeping the nation has been responsible for over half a million deaths as of 2020. Noticeably, there has been a shift in the overdose etiology over the last decade or so. Heroin and semisynthetic opioids have shown a progressive decrease as the primary causative agent. Meanwhile, the synthetic class of opioids rose to prominence as the leading drug agent in overdose. As the morbidity and mortality of opioid misuse continues to plague society and the frequency of synthetic drug deaths continue to rise, an understanding of new synthetic drugs and recognition of their presentations is of paramount importance for healthcare providers.
Case report: A 23-year-old male with history of polysubstance abuse presented to the emergency department after being found unresponsive in his home after insufflating an unknown amount of powdered protonitazene. According to his family, he had been weaning himself off his suboxone prescribed for opiate use disorder. To accomplish this self-taper, he concocted a tincture of grain ethanol, propylene glycol and powered protonitazene. He received naloxone prehospital without significant improvement and was intubated for airway protection and hypoxemia on arrival to the emergency department. Vasopressors were also required for cardiovascular instability. Once family arrived at the bedside, they reported he had also been abusing designer benzodiazepines, specially etizolam.
Discussion: Although first synthesized in the 1950's, benzimidazole class opioid agonists have recently emerged as a significant public health risk. These benzimidazole structures exploit numerous side chain modifications affecting potency. Protonitazene, the strongest of these compounds, exhibits a 200-fold increase in potency when compared to morphine and twice that of fentanyl. Retrospective toxicologic analyses have identified frequent concomitant use of benzodiazepines (as in this patient). Social media and darknet websites have been cited as the frequent source for these drugs, which are not approved for medical use in the US. Given the well-studied risk of high potency Mu opioids and respiratory depression and death, protonitazene represents a reemerging compound that could be implicated in numerous overdoses and deaths however escaping detection given lack of available testing methods. The addition of GABA agonists also confounds the expected opioid toxidrome making diagnosis strictly based on clinical findings almost impossible. This highlights the utility of strong history taking and need to obtain collateral information.
Conclusions: Vasopressors were quickly weaned and he was extubated after 20 h. He was able to endorse his insufflation of protonitazene as well as concomitant use of etizolam prior to losing consciousness. His workup was found to have changes on brain MRI concerning for distal bilateral ischemic infarcts. We report an isolated case of an unintentional overdose involving protonitazene, a benzimidazole class, high-potency mu agonist that has significant potential to worsen morbidity and mortality of the current opioid epidemic.

KEYWORDS Opioids; protonitizene; designer drugs
emanuel.jackson2@prismahealth.org

221. Crouching zookeeper, hidden dragon: a Komodo dragon bite

Nate Friedman[a] and Richard Clark[b]

[a]University of California – San Diego, San Diego, CA, USA; [b]UCSD Medical Center, San Diego, CA, USA

Background: The world's largest lizard, the Komodo dragon (*Varanus komodoensis*), can grow up to ten feet and weigh up to ninety kilograms. While native to Indonesia, they are found in captivity worldwide. They are carnivorous apex predators capable of hunting prey as large as a water buffalo and occasionally attack humans. Their method of killing remains under debate; prior beliefs that V. komodoensis mouths contain highly pathogenic bacteria and lead to rapid overwhelming sepsis has been questioned. Dissections of Komodo dragon mouths have demonstrated the presence of venom sacs, though their envenomation potential remains unknown. We report a case of a zookeeper who was bitten by an adult Komodo dragon who was managed with local wound care and outpatient antibiotics.
Case report: A 43-year-old zookeeper was working in an enclosure when an adult, gravid Komodo dragon bit him on the left lower leg and clawed his right lower leg. The dragon subsequently latched on to the fabric of his pants, which the zookeeper then cut away from himself with a knife. He presented to our emergency department shortly thereafter complaining of mild bilateral leg pain but no noticeable bleeding. He denied any past medical history and took no medications. On physical exam, he sustained multiple linear lacerations to the anterior and posterior left leg with some gaping of the wound edges, along with a more superficial set of lacerations to the lateral right leg. His neurovascular exam was normal and radiography revealed no foreign bodies. Laboratory evaluation revealed an INR of 1.1. The wounds were irrigated under pressure and the largest wound was loosely approximated with five sutures of 3–0 nylon. His Tdap was updated, and he was placed on a ten-day course of amoxicillin-clavulanic acid 875 mg-125 mg. On phone follow-up on days 2 and 10, the patient reported doing well with no signs or symptoms of infection or bleeding. No neurologic complications were experienced following the bite.
Conclusions: Komodo dragon bites, while infrequent, are of interest to emergency practitioners and medical toxicologists as the management of these bites is not well established. Prior assumptions that pathogenic bacteria induce a fatal sepsis may

be unfounded, and the ability of Komodo dragons to deliver venom to prey has not been conclusively demonstrated, compared to the known venomous capabilities of other important lizards. Conservative management with antibiotic prophylaxis appears to be a reasonable strategy for most Komodo dragon bites.

KEYWORDS Komodo dragon; envenomation; lizards

nafriedm@gmail.com

222. Decontamination with olive oil and hemofiltration in a potentially lethal zinc phosphide ingestion

Jorge Guillermo Pérez Tuñón[a], Mayré Ivonne Bautista Albíter[b], Sindy Lucero Ortega Martínez[c], Natanael del Angel Gonzalez[b] and Yadira Jodisel Rosales Bacilio[d]

[a]Centro Toxicológico Hospital Angeles Lomas, Mexico City, Mexico; [b]Hospital Angeles Lomas, Huixquilucan, Mexico; [c]Centro Toxicológico Hospital Ángeles Lomas, Huixquilucan, México; [d]Hospital Ángeles Lomas, Huixquilucan, Mexico

Background: Metal phosphides are restricted pesticides that due to their low cost and high effectiveness, are widely used as rodenticides and fumigants in Mexico. These compounds, in the presence of a moist or acidic environment release phosphine (PH3), which is a colorless, water-soluble and flammable gas, with a garlic or fish odor that is attributed to impurities such as substituted phosphines, diphosphines, and arsine. The exact mechanism by which phosphine acts is not clear, however, has been demonstrated that inhibits oxidative phosphorylation and generates highly reactive free radicals. This report describes the use of olive oil, supportive measures, and hemofiltration as a successful treatment for a potentially lethal zinc phosphide ingestion.
Case report: A 50-year-old female with a history of depressive disorder presented to the hospital 30 min after ingesting 50 g of zinc phosphide in a suicide attempt. While she was still inside the store, she added the zinc phosphide to a bottle with water and drank it all. The event was witnessed by her daughter, who took her to the hospital. In the emergency department she was with abdominal pain, garlic smell, blood pressure 90/60 mmHg, heart rate 104 bpm and respiratory rate 24 rpm. The initial approach was started and the patient was intubated for airway protection. Gastric emptying was performed immediately, after which replacements were made with aliquots of 150 mL of olive oil until the effluent turned negative. After that, patient was admitted to intensive therapy in a negative pressure room, however, despite the treatment she developed hypotension, followed by metabolic acidosis with hyperlactatemia. Because of this, infusions with norepinephrine and sodium bicarbonate were started, although the acidosis persisted and it was necessary to start continuous veno-venous hemofiltration, with which a gradual improvement was observed. She was discharged 5 days later to continue psychiatric treatment.
Discussion: Death has been reported following ingestion of 4 g of zinc phosphide, so in the present case, the risk of lethality without treatment was very high. Probably, the main factor related to her survival was the short time in which she was brought to the emergency room, because gastric emptying was started 30 min after ingestion, followed by gastric lavage with olive oil and early start of the support measures. Despite this, she developed intoxication, therefore hemofiltration was started. This technique should have increased phosphine clearance due to its toxicokinetic properties such as its low molecular mass and its water solubility. On the other hand, olive oil is not only a fluid that does not react with metal phosphides, but it also represents a source of antioxidants above other edible oils, although it should be noted that the benefit of this property has not been proven and there is a risk of aspiration in comatose patients if the airway has not been protected. Due to this, we consider that it is necessary to carry out comparative studies before considering the use of olive oil or hemofiltration as the therapies of choice in metal phosphides ingestions.

KEYWORDS Metal phosphides; gastric lavage; hemofiltration

3tunon@gmail.com

223. Cardiac arrest and multisystem organ failure after inhalant abuse with recovery following VA ECMO

Ronald Kirschner[a] and Karen Smith[b]

[a]University of Nebraska Medical Center, Omaha, NE, USA; [b]Nebraska Regional Poison Center, Omaha, NE, USA

Background: Inhalation abuse of halogenated hydrocarbons has been associated with ventricular dysrhythmias that are sometimes fatal. We report a patient who was resuscitated, found to have severe cardiomyopathy, but recovered after venoarterial extracorporeal membrane oxygenation (VA ECMO).
Case report: This is a single patient chart review. A 32-year-old man with a history of poly-substance abuse was brought to a community hospital ED by EMS for dyspnea after inhalation of keyboard cleaner with difluoroethane propellant. He initially had a narrow complex rhythm with a rate of 152 thought to be a supraventricular tachycardia, but unresponsive to adenosine. The patient was transferred to a regional medical center where he had multiple runs of ventricular tachycardia/fibrillation requiring antidysrhythmics, cardioversion, and endotracheal intubation. At that point he was in cardiogenic shock, prompting a second transfer to a heart transplant center (HTC). On arrival at the HTC, the patient had a heart rate of 118 bpm and blood pressure 111/73 mmHg (on a mechanical pump assist device with amiodarone, lidocaine, epinephrine, dopamine, norepinephrine, and vasopressin infusions). Labs were significant for arterial pH of 7.11, sodium 154 meq/L, chloride 97 meq/L, bicarbonate 22 meq/L, anion gap 35, creatinine 3.35 mg/dL, AST 16,380 IU/L, ALT 6615 IU/L, bilirubin 1.5 mg/dL, CK 5819 U/L, troponin I 56.45 ng/mL, and lactate 23.1 mmol/L. A cardiac echo showed severe biventricular systolic dysfunction with ejection fraction (EF) ~ 5%. The patient was cannulated by cardiothoracic surgery and VA ECMO was started. Vasopressors and antidysrhythmics were tapered off. CK and transaminases gradually improved. The patient was able to tolerate extubation and mental status appeared be at or near baseline. He confirmed the history of keyboard cleaner abuse and denied coingestants. Repeat cardiac echo (four days after initial) showed markedly improved ventricular function (EF 60–65%), and VA ECMO was discontinued. Kidney function initially improved, then declined and the patient required hemodialysis. On day 18 at the HTC, he was discharged home in stable condition with arrangements for outpatient dialysis.
Discussion: Following inhalant-precipitated dysrhythmias, the patient presumably had ischemic injury to vital organs including liver, kidney, and myocardium. The role of VA ECMO in poisoning can include allowing time for extracorporeal removal or endogenous clearance of a toxicant. In this case, because the responsible substance had likely cleared by the time the patient arrived at the HTC, difluoroethane concentrations were not obtained. However, VA ECMO provided hemodynamic support while the myocardium recovered.

Conclusions: VA ECMO can provide a bridge to recovery in patients with myocardial injury following inhalant abuse.

KEYWORDS Inhalant abuse; ECMO; halogenated hydrocarbons

rkirschner@nebraskamed.com

224. Utility of an ED-ICU in the management of the poisoned patient

William Rushton[a], Erin Ryan[a], Jessica Rivera Pescatore[b], Sukhshant Atti[c], Adam Kessler[c] and Caitlin Fellers[b]

[a]Alabama Poison Information Center, Birmingham, AL, USA; [b]Department of Pharmacy, University of Alabama at Birmingham, Birmingham, AL, USA; [c]Department of Emergency Medicine, University of Alabama at Birmingham, Birmingham, AL, USA

Background: The emergency department based intensive care unit (ED-ICU) allows for the provision of ICU level care to patients within the ED. These patients are typically under the care of a provider co-trained in emergency and intensive care medicine. Such a model allows for intensive monitoring or treatment during the period of peak xenobiotic effects and may be particularly useful when effects are expected to be short-lived (<24 h). This study aimed to characterize utilization of the ED-ICU for poisoned patients at a single academic medical center.
Methods: This was an observational study of patients treated in an ED-ICU between August 2019 through January 2022. Data on patient demographics, exposure, and clinical course were abstracted from hospital medical records by a single reviewer and descriptive statistics were calculated.
Results: Thirty-four exposures were managed in the ED-ICU during the study period. Median patient age was 44.5 years (IQR: 36.25–51.5 years) and 24 (70.8%) were male. The most common exposure involved opioids ($n = 10$), followed by sedative-hypnotics ($n = 4$), antidepressants ($n = 3$), insulin ($n = 3$), and sympathomimetics ($n = 3$). Three body stuffers were managed in the ED-ICU. Other exposures treated in the unit included antimuscarinics, beta antagonists, calcium channel antagonists, carbon monoxide, antipsychotics, hydrofluoric acid, anticonvulsants, alpha-1 antagonists, and digoxin. Thirteen patients experienced respiratory failure warranting admission to the ED-ICU; 11 patients required intubation and 2 patients needed bilevel positive airway pressure (BiPAP). Three patients developed hypotension requiring hemodynamic support with vasopressors. Antidotes administered in the ED-ICU included naloxone ($n = 7$), dextrose ($n = 3$), sodium bicarbonate ($n = 1$), and calcium ($n = 1$). The mean length of stay (LOS) in the ED-ICU was 18.5 h, with 73.5% of patients remaining in the unit <24 h and 35.3% <12 h. Thirteen patients (38.2%) were either discharged directly from the ED-ICU ($n = 11$) or medically cleared and admitted to psychiatry ($n = 2$), while the remaining 21 were admitted to the hospital. Of these, only 3 required admission to the ICU, which were antidepressant and insulin poisonings. Two of the three inpatient ICU admissions went on to require ICU stays of longer than a week (306 h and 545.2 h). The ED-ICU was successfully utilized in the management of a variety of toxicologic exposures and may be especially useful for opioid intoxication, which comprised more than a quarter of total cases. Critical care interventions such as continuous monitoring, intubation, vasopressor support, and administration of reversal agents and antidotes were provided. Furthermore, the ED-ICU allowed for successful extubation. Over a third of patients treated in the ED-ICU were able to be discharged or transferred to psychiatric services. Additionally, most admitted patients did not require ICU level care following stabilization in the ED-ICU. This suggests that some poisoned patients who would otherwise be admitted to the inpatient ICU can instead be monitored and resuscitated in the ED-ICU.
Conclusions: The ED-ICU allows for close monitoring and critical care interventions in poisonings while patients are still in the ED. This model of care may minimize inpatient ICU admissions and preserve strained hospital resources.

KEYWORDS ED-ICU; critical care; emergency department

wrushton@uabmc.edu

225. Ventricular fibrillation in a 21-year-old after inhalation of volatile hydrocarbons, alcohols, and nitrites labeled as an isobutyl nitrite "popper" product

Brian Gooley[a], Thomas Lofy[b], Joshua Gross[a], Taylor Sonnenberg[a] and Ryan Feldman[a]

[a]Froedtert and Medical College Of Wisconsin, Milwaukee, WI, USA; [b]University of Wisconsin Madison School of Pharmacy, Madison, WI, USA

Background: Alkyl nitrite analogs known as "poppers" have been inhaled recreationally for decades. These products are commonly marketed as nail polish removers, leather cleaners, or room odorizers and can be purchased on the internet or in retail stores. Life-threatening acute side effects such as ventricular dysrhythmias are not commonly reported.
Case report: A 21-year-old male with history of inhalational "popper" use on a weekly to monthly basis for approximately 1 year was found by family in cardiac arrest. He received cardiopulmonary resuscitation from family until paramedics arrived and found the patient to be in ventricular fibrillation. He received two defibrillations and ROSC was achieved 28 min after being found down. A bottle of "Amsterdam acetone free nail polish remover" labeled to contain isobutyl nitrite was discovered near the patient. He was transported to the emergency department and had complete neurologic recovery 4 h after his arrest. On interview he endorsed inhaling the "Amsterdam" product just prior to his arrest and denied co-ingestion of any other substances. His initial electrocardiogram showed normal sinus rhythm without interval abnormalities or signs of channelopathy. A transthoracic echocardiogram (TTE) and stress test one day after exposure were normal and he was discharged with a loop monitor. On follow up 6 weeks later the loop recorder demonstrated no arrhythmic abnormalities and a repeat TTE showed normal cardiac function. The "Amsterdam" product was sent to the Wisconsin State Lab of Hygiene for analysis with gas chromatography and mass spectrometry. The mass spectral library provided matches with numerous compounds. The relative composition of the solution was inferred via the size of the peak for each component. The largest peak was isobutyl alcohol, followed by tert-butanol, and 1,1-dibutoxy-butane. Isobutyl nitrite was present as the 5th largest peak.
Discussion: The mechanism leading to ventricular fibrillation in this patient is unknown. One prior case of amyl nitrite induced ventricular fibrillation occurred in a patient many hours after their last use. The mechanism of arrhythmia in that patient was thought to be ischemia from rebound coronary vasoconstriction. Tissues exposed to nitrites display increased oxygen free radicals, which may scavenge nitric oxide, and cause "rebound" vasoconstriction when the nitrite dissipates. As our patient was actively using the product during arrest this mechanisms is unlikely. Another mechanism may be arrhythmia from hydrocarbon induced cardiac catecholamine sensitization ("Sudden sniffing death"). The third most prevalent compound in the product was

1,1-dibutoxy-butane and isobutyl was present as both alcohol and nitrite. Additionally, numerous hydrocarbons were identified on analysis. It is possible these, or any of the other volatile organic compounds, may be capable of producing cardiac catecholamine sensitization and arrhythmia.
Conclusions: Users of alkyl nitrite "poppers" and treating clinicians should be aware that products labeled to contain nitrites may contain volatile hydrocarbons, alcohols, and other substances, along with nitrites. While the mechanism is unknown, use of these products labeled to carry alkyl nitrites has the potential for life threatening arrhythmia.

KEYWORDS Popper; inhalant; nitrite

gool0016@umn.edu

226. Tea tree oil exposures involving dogs reported to poison centers

Jeanie E. Shawhart[a] and Mathias Forrester[b]

[a]Texas Tech University Health Sciences Center Jerry H. Hodge School of Pharmacy, Amarillo, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Tea tree oil (also known as melaleuca oil) is a volatile essential oil containing 50–60% terpenes. Having bactericidal and fungicidal properties and being readily absorbed through the skin, tea tree oil is used topically to treat skin conditions in humans and animals. In addition, tea tree oil is used in vaporizers and baths to treat respiratory tract disorders. It also may be found in perfumes, aromatherapy products, toothpaste, soaps, and skin creams and lotions. Tea tree oil is available over the counter in the US. Topical use of tea tree oil may result in irritation and allergic reactions. Tea tree oil also may cause harm if ingested. Adverse effects reported in dogs include central nervous system depression, lethargy, listlessness, somnolence, paresis, weakness, ataxia, muscle tremors, vomiting, coma, dermatitis, and increased salivation. Several deaths in dogs have been reported. The objective of this study was to describe tea tree oil exposures involving dogs reported to poison centers that primarily manage human exposures.
Methods: Cases were tea tree oil exposures (Generic code 0201026) reported to a large, statewide poison center network during 2000–2020 where the patient species was animal and the animal type was dog. The distribution of cases was determined for various factors.
Results: Fifty-six tea tree oil exposures involving dogs were identified. Thirty-one (55.4%) of the exposures occurred by dermal route, 29 (51.8%) by ingestion, and 2 (3.6%) by otic route; 6 (10.7%) of the exposures occurred by more than 1 route. The exposure occurred at the home of the dog's owner or caregiver in 31 (55.4%) cases and was at an unknown location in 25 (44.6%) cases. The management site was 30 (53.6%) on site (outside of a healthcare facility), 24 (42.9%) at a healthcare facility or other location (probably a veterinarian facility), and 2 (3.6%) at an unknown location. A clinical effect was reported in 25 (44.6%) of the exposures. The most commonly reported clinical effects were ataxia ($n = 8$, 14.3%), drowsiness/lethargy ($n = 5$, 8.9%), paralysis ($n = 4$, 7.1%), and vomiting ($n = 3$, 5.4%). Other clinical effects reported in 1–2 cases were central nervous system depression, tremor, muscle weakness, agitation, seizure, respiratory arrest, dyspnea, confusion, and cardiac arrest. The exposure was not serious (no effect, minor effect, moderate effect, not followed-judged nontoxic, not followed-minimal effects possible) in 22 (39.3%) cases, serious (moderate effect, major effect, death, unable to follow-potentially toxic) in 33 (57.1%), and unrelated to the exposure in 1 (1.8%); there was 1 death, but the poison center network generally does not follow animal exposures to determine final outcome. The reported treatment was dilute/irrigate/wash ($n = 26$, 46.4%), intravenous fluids ($n = 2$, 3.6%), and 1 (1.8%) each antiemetics, glucose, and other emetic.
Conclusions: The highest proportion of reported tea tree oil exposures involving dogs occurred by dermal route followed by ingestion. Exposures with a known location occurred at the home of the dog's owner or caregiver. The majority of exposures were managed on site. However, most exposures were considered to have potentially serious outcomes.

KEYWORDS Poison center; dog; tea tree oil

jeanie.jaramillo@ttuhsc.edu

227. Large dose sertraline ingestion associated with a false-positive urine immunoassay for benzodiazepine

Lindsay Bernardo[a], Khushbu Patel[b], Aaron Chen[a] and Kevin Osterhoudt[c]

[a]Division of Emergency Medicine, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [b]Chemistry Laboratory, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [c]Section of Clinical Toxicology, Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background: Urine drug screening is a common test performed in hospitals, in the criminal justice system, in qualification testing for life insurance or for employment, and in other settings. Many tasked with interpreting urine drug screen results, including healthcare providers, may be unaware of the limitations of these tests. False positive urine drug tests may have untoward consequences. We report sertraline as a potential cause of false-positive benzodiazepine testing on urine immunoassay-based drug screening.
Case report: A 14-year-old girl reported intentional ingestion of an estimated 2000 mg of sertraline. Due to somnolence, vomiting and diarrhea she was taken to an emergency department. She had recently been prescribed lamotrigine and guanfacine but was not taking them, and she reported that she was no longer taking previous prescriptions for mirtazapine or aripiprazole. She did report occasional use of marijuana and ethanol, but denied other non-prescribed drug use. Her physical exam was notable for somnolence, mild tachycardia, and mild tremor. An ECG had a rate of 119/min, QRS 88mSec and QTc 464mSec. A urine drug immunoassay (Vitros 4600 Chemistry®, Ortho-Clinical Diagnostics) was performed which was negative for amphetamine, barbiturate, cannabinoids, cocaine, opiates (including buprenorphine, fentanyl and methadone), and phencyclidine; but, which was surprisingly positive for benzodiazepines. The girl's family reported lorazepam within the household but felt the prescription was intact, and the girl denied use of benzodiazepines. No ethanol was detected in serum. Gas chromatography – mass spectroscopy drug analysis of the urine identified only a large peak of sertraline in the sample. The urine sample was sent for specific benzodiazepine confirmation by quantitative liquid chromatography – tandem mass spectroscopy and no benzodiazepine drugs were found. The girl recovered over ensuing hours and was connected with mental health services.
Discussion: Proper identification of un-prescribed benzodiazepine use is important as it may be a target for therapy, and abrupt cessation may be associated with severe withdrawal. False-positive benzodiazepine testing may lead to misdiagnosis, inappropriate treatment, damaged therapeutic alliance, and stigma. False positive drug testing may also lead to erroneous decisions of ineligibility for employment or other programs. In this case, it was concluded that the urine immunoassay drug screen was falsely positive for benzodiazepines due to cross-reactivity with sertraline; neither the emergency department clinicians nor the

mental health services team were aware of this circumstance. According to the package insert of the Vitros® system used, sertraline is a known interferent: sertraline at a concentration of 0.5 mg/dL will be detected as a benzodiazepine using the 200 ng/mL cutoff value. Similar interferences have been previously noted using other commercial analyzer systems.
Conclusions: Many healthcare providers have limited knowledge of urine drug immunoassay cross-reactivity data. Antidepressant drugs, such as sertraline, are commonly prescribed and patients with depression are at risk for medical evaluation for intentional drug ingestion/overdose. We add evidence to the principle of false-positive benzodiazepine urine drug screen results due to sertraline, and alert healthcare providers to this phenomenon.

KEYWORDS Sertraline; urine drug screen; false positive

bernardol@chop.edu

228. "Tranq dope" in infancy: a 19-day-old with life-threatening poisoning due to fentanyl/xylazine

Zachary Miller[a], Emily Gill[b], Grace Kelly[c], Richard Latuska[c], Leonel Toledo[d], Phil Scribano[a] and Kevin Osterhoudt[e]

[a]Safe Place, The Children's Hospital of Philadelphia, Philadelphia, PA, USA; [b]Toxicology Laboratory, Hospital of the University of Pennsylvania, Philadelphia, PA, USA; [c]Division of Emergency Medicine, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [d]Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA, USA; [e]Section of Clinical Toxicology, Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background: More and more, young children are victims of the ongoing epidemic of opioid use disorder. Xylazine, an alpha-2 adrenergic agonist with notorious use as a veterinary tranquilizer, is an increasingly encountered component of the illicit opioid supply in the US, but has been rarely documented in biological samples obtained from children. We report a 19-day-old infant with classic manifestations of central nervous system and respiratory depression associated with fentanyl and xylazine poisoning.
Case report: A 19-day-old boy was taken to the emergency department (ED) by his parents for episodes of straining, breath-holding, and his eyes rolling backwards. The formula-fed boy was born of an uncomplicated full-term spontaneous vaginal delivery and had previously been thriving. During ED triage assessment he had a period of apnea, then bradypnea, with pulse-oximetric oxygen saturation drop to 55%. He was supported with stimulation and supplemental oxygen via non-rebreather mask but remained lethargic, with temperature 96F, heart rate 166/min, and brisk capillary refill. Point of care blood dextrose testing was 88mg/dL. Analysis of respiratory secretions for common viruses by polymerase chain reaction was negative for respiratory syncytial virus, influenza, or SARS-CoV-2. Computed tomography imaging of the brain was unremarkable. A urine drug immunoassay (Vitros 4600 Chemistry®, Ortho-Clinical Diagnostics) resulted positive for fentanyl (cutoff 1 ng/mL), but negative for amphetamine, barbiturate, benzodiazepine, cannabinoids, cocaine, heroin, morphine, buprenorphine, methadone, or oxycodone. Liquid chromatography tandem mass spectroscopy analysis of the urine confirmed the presence of fentanyl (25 ng/mL) and norfentanyl (245 ng/mL). Gas chromatography with mass spectrometry also detected the presence of xylazine (qualitative result based on spectra matching). Over the ensuing hours the boy recovered fully and the family was connected with child protection services; an exposure route was not identified.
Discussion: This 19-day-old infant suffered fentanyl/xylazine poisoning. The infant's age and urine fentanyl concentrations exclude pre-natal exposure as an explanation for the drug test findings, and the baby was bottle-fed excluding drug transmission through breast milk. Xylazine has been known to be in this hospital's regional heroin supply since the early 2000s, and in 2019 xylazine was implicated in more than 31% of opioid-associated deaths at the city's medical examiner's office. In 2022, many fentanyl samples tested by regional law enforcement find more xylazine than fentanyl. Until recently, xylazine was an uncommon finding in our testing of pediatric opioid poisoning victims. Similar to fentanyl, xylazine may cause pupillary miosis and CNS depression; unfortunately it may be resistant to reversal with naloxone.
Conclusions: This case is remarkable for the young age of this infant ill from post-natal fentanyl poisoning and for the detection of xylazine in his urine. Healthcare providers may not immediately consider opioid poisoning in the differential diagnosis of infants with altered mental status, and proper toxicological testing is important for appropriate child protection support. Detection of xylazine is a marker for a non-medical, or "street," source of fentanyl.

KEYWORDS Xylazine; fentanyl; opioid

millerz1@chop.edu

229. Acute clobazam toxicity resulting in death

Dalton Grimm[a], Bryan Judge[a], Bernard Eisenga[b] and Brad Riley[a]

[a]Spectrum Health – Michigan State University Emergency Medicine Residency Program, Grand Rapids, MI, USA; [b]Department of Toxicology, Spectrum Health Hospitals, Grand Rapids, MI, USA

Background: Clobazam is commonly used as an adjunctive therapy for focal seizure prevention. It is typically well tolerated and tends to result in less sedation than other drugs in its class. There are two cases of clobazam toxicity in the current literature, with only one case reporting clobazam ingestion as the cause of death. In this case report, we present a second instance of acute clobazam ingestion resulting in cardiac arrest and ultimately death.
Case report: A 32-year-old female with history of type 1 diabetes, partial epilepsy, and depression, presented to our emergency department (ED) after cardiac arrest. Her partner found her face down in bed, cyanotic and apneic. He immediately started CPR. When emergency medical services arrived several minutes later, she was asystolic. Pulses returned after 2 cycles of CPR and 2 doses of epinephrine. She was intubated en route to the ED. According to partner, the patient had been "taking her seizure medication, clobazam, like candy" and he had received a text message stating that the patient wanted to kill herself. On arrival to the ED, she was found to be bradycardic and transcutaneous pacing was initiated. The patient remained unresponsive with a Glasgow coma score of 3T despite naloxone. Bradycardia resolved after epinephrine infusion, calcium, and bicarbonate, and transcutaneous pacing was then stopped. EKG then showed a normal sinus rhythm with right bundle branch block. Initial labs revealed pH 6.75, potassium 6.7, bicarbonate 11, anion gap 21, creatinine 1.32, glucose 650, AST 755, ALT 360, lactate 14, and beta hydroxybutyrate 1.54 suggesting concomitant DKA. The patient was given 4 liters IV fluids, started on insulin infusion, norepinephrine, vasopressin, and bicarbonate drips. Computed tomography of the head revealed cerebral edema with bilateral tonsillar herniation compatible with anoxic brain injury. Quantitative clobazam level drawn the day after admission returned elevated at 1940 ng/mL (reference range 30–300 ng/mL) with the active metabolite N-desmethylclobazam elevated at 6480 ng/mL (300–3000 ng/mL). Due to the prolonged half-life of

clobazam and its metabolites (up to 82 h), prognostic neurologic exam and brain death protocols were held (for 5 half-lives). The patient subsequently developed severe hyponatremia, was found to have extensive bilateral pulmonary emboli and extensive necrotizing pneumonia. Brain death exam was ultimately completed 19 days after admission.
Discussion: Although there have been very few cases of clobazam toxicity reported in the literature, it is pertinent that emergency physicians consider this diagnosis in patients presenting with typical signs of benzodiazepine overdose. Serum levels of both clobazam and N-desmethylclobazam should be obtained to aid in accurate diagnosis, though these will not be helpful in early management. Supportive care, particularly airway management, is the cornerstone of care for acute toxicity.
Conclusions: Clobazam can result in respiratory arrest and death as demonstrated in this case. Physicians should be cautious in prescribing this medication, with particular emphasis on discussion of adverse effects, toxicity, and inherent danger in patients with history of depression or suicidal ideation.

KEYWORDS Clobazam; toxicity; cardiac arrest

dalton.grimm@spectrumhealth.org

230. *Crataegus mexicana* (tejocote) exposure associated with pancreatitis

Kyle Sherwin and Brad Riley

Spectrum Health – Michigan State University Emergency Medicine Residency Program, Grand Rapids, MI, USA

Background: A species of hawthorn, *Crataegus mexicana* (tejocote), has been marketed as a weight-loss supplement that is readily available for purchase online. While several hawthorn species have shown clinical benefit in the treatment of heart failure owing to their positive inotropic effects, little is known about hawthorn, and tejocote in particular, when consumed in excess. We describe a case of tejocote exposure which precipitated new onset diabetic ketoacidosis (DKA) with pancreatitis.
Case report: A 46-year-old female with no significant past medical history who presented to the emergency department with the chief complaint of fatigue, food aversion and intermittent nausea. Symptoms had been ongoing on for the last 4 days after the patient stopped taking Mexican Hawthorne root, which she had been consuming in standard doses for the last 4 months. During this period, she had lost 30 lbs. The patient appeared extremely ill, tachycardic and tachypneic. She also displayed an acutely tender abdomen in the epigastric region with voluntary guarding. After 2 L of fluid resuscitation the patient's vitals remained unchanged. Bedside ultrasound showed a completely collapse IVC, consistent with severe hypovolemia which progressed to shock eventually requiring norepinephrine after 5 total liters of fluid resuscitation. Later it was discovered that the patient had a diagnosis of "pre-diabetes." Pertinent laboratory work revealed new onset diabetic ketoacidosis (DKA) with initial pH 7.18, beta hydroxybuterate >9 mmol/L (normal 0.1–0.4), glucose of 1232 mg/dL. Computed tomograpgy of the abdomen with contrast revealed acute pancreatitis and a lipase of 2344 U/L. Patient's hospital course was complicated by encephalopathy, pneumonia, splenic thrombosis and as bilateral lower extremity DVT's. She was discharged on hospital day 14 on insulin and apixaban.
Discussion: Hawthorn is considered safe in therapeutic doses, and serious adverse effects are rare in the literature. To our knowledge, this is the first reported case of toxicity from tejocote root (*C. mexicana*) ingestion, and hawthorn species in general, which resulted in acute pancreatitis, new onset DKA and hypovolemic shock. In one systematic review of over 5000 patients taking standard doses of hawthorn extract, only 166 patients reported transient, non-life threatening adverse effects such as dizziness, GI complaints, palpitations and headache.
Conclusions: Tejocote (*C. mexicana*) root ingestion may result in pancreatitis with associated DKA when consumed in standard doses. Clinicians should be aware of the potential toxicity and side effects of these and other readily available tejocote root products.

KEYWORDS Tejocote; hawthorne; pancreatitis

kyle.sherwin@spectrumhealth.org

231. Rare overdose of veterinary anesthetic romifidine causing hypotension and bradycardia

Daniel Rivera and Kapil Sharma

University of Texas Southwestern Medical Center, Dallas, TX, USA

Background: Alpha 2 agonists have a variety of therapeutic indications in human clinical use. In overdose they classically cause respiratory depression, hypotension, and bradycardia. These medications also exist in the veterinary field and are typically used as anesthetics. We present one of the first reported human exposures to the agent romifidine, an alpha 2 agonist used primarily to anesthetize horses. This patient developed the classic toxicity of somnolence, hypotension, and bradycardia but without any respiratory compromise. After a literature search for other exposures, only one other documented human case was found, with a similar clinical toxicity as our patient. This is a single case report.
Case report: A 42-year-old male with a significant past medical history of diabetes, hypertension, seizures, and chronic abdominal pain with gastroparesis presented to an outside hospital with a reported romifidine overdose. He was found semi-conscious by family at his home. Emergency medical services arrived to assess and en route to the hospital he received a 500 mL bolus of normal saline. In the emergency department his initial blood pressure was 88/56 mm Hg and his heart rate was 45 beats per minute. An initial EKG showed sinus bradycardia and a QTc of 505. Initial lab values were notable for a normal white cell count, normal electrolytes, normal anion gap, normal lactic acid, and a creatinine of 1.38 mg/dL. The patient admitted to having obtained the veterinary anesthetic romifidine from a work colleague. He self administered 0.5 mL of intramuscular romifidine 1%, for 5 mg total. The patient was attempting to alleviate his chronic abdominal pain with this injection. The treating physician contacted our poison control center for a consultation with medical toxicology. Romifidine structurally is similar to well known alpha 2 agonists like clonidine. It has the same base ring structure with the substitution of the two chlorine molecules for fluorine and bromine. Given the functionally similar presentation to other alpha 2 agonist overdoses we recommended pressors, fluids, atropine for bradycardia, airway support, and continued supportive measures. The treating team started a dopamine infusion and he was admitted to the step down unit. His mean arterial pressure improved to normal, and his heart rate improved to the 70s initially, however he remained intermittently bradycardic over the next 24 h. He remained on a dopamine infusion until it was weaned off on hospital day three. The patient was further stabilized from his chronic conditions and he was discharged on hospital day four.
Conclusions: Overdose of alpha 2 agonists are a common scenario in toxicology and are typically treated with pressors and supportive care. In this rare exposure of romifidine, literature is very limited for human exposures, but it is well known as an anesthetic and pain medicine in the veterinary field. Based on the structural similarities and clinical toxicity, our case demonstrates

that pressors and excellent supportive care are a good option for treating these rare overdoses.

KEYWORDS Romifidine; clonidine; bradycardia

daniel.rivera@utsouthwestern.edu

232. *Bothriechis marchi* envenomation treated with crotalidae immune F(ab')$_2$ antivenom

Michael Semple, Evan Schwarz and Kevin Baumgartne

Washington University School of Medicine, St. Louis, MO, USA

Background: *Bothriechis* is a genus of vipers from the Crotalinae subfamily commonly referred to as palm vipers. Few documented envenomations are reported. A literature search did not reveal any documented cases of envenomation by Honduran palm pit viper (*Bothriechis marchi*). We present a case of a patient envenomated by their pet Honduran palm viper.
Case report: A 52-year-old man with a past medical history of hypertension, alcohol-induced cirrhosis, hepatitis C, and six previous non-native snake envenomations was bitten on his left long finger by his Honduran palm viper while attempting to feed the animal. While awaiting emergency medical services (EMS) arrival, he became dyspneic, light-headed, and developed difficulty concentrating. On EMS arrival, he was somnolent and hypoxic, with an initial oxygen saturation of 77% on room air. His blood pressure and heart rate were normal. EMS administered NRB at 15L and oxygen saturations improved to 90%. Upon arrival to the Emergency Department (ED), he was hypotensive with a blood pressure (BP) of 90/75 mmHg; within 9 min his BP worsened to 69/43 mmHg. 1.5 liters of normal saline were administered without improvement. He received dexamethasone, famotidine, IM epinephrine and IV phenylephrine. He was not wheezing and did not have a rash. He remained hypotensive requiring initiation of a norepinephrine infusion starting at 0.05 mcg/kg/min. On exam, he had two puncture marks on his left long finger with bleeding and swelling that extended to his proximal forearm. Deformities were not present, but he did have decreased range of motion due to pain and his fingertip was dark. He did not demonstrate any muscle weakness. Initial laboratories were significant for a WBC 16.8 K/cumm, Hgb 17.5 g/dL, Hct 51.2, aPTT 34 s, PT 21.0 s, INR 1.9, and fibrinogen 191 mg/dL. Ten vials of Crotalidae immune F(ab')$_2$ (Anavip®) were administered. He was admitted to the ICU and remained on a norepinephrine infusion for less than 6 h with a maximal rate of 0.07 mcg/kg/min. The norepinephrine was stopped 5 h after administration of the antivenom. Three hours after administration of antivenom, his pain and swelling had improved, and he had full range of motion (ROM) in his wrist and hand; ROM was still limited in his envenomated finger. His initial mild coagulopathy corrected to an INR of 1.1 and PT of 12.6 approximately 4 h after presentation and 3 h after antivenom administration. Fibrinogen, PT, aPTT, and Hgb remained in normal ranges during admission. He underwent bedside fingertip decompression by orthopedics and was discharged about 36 h after presentation. He did not follow up with outpatient toxicology.
Discussion: In this case of *B. marchi* envenomation, hypotension and coagulopathy improved after administration of F(ab')$_2$ antivenom. F(ab')$_2$ antivenom is derived from the venom of *Bothrops asper* (Fer-de-lance) and *Crotalus durissus* (South American Rattlesnake), which may make it a better selection of antivenom when compared to crotalidae polyvalent immune fab [ovine] (CroFab®). Accordingly, F(ab')$_2$ is recommended by the WCH Adelaide, Australia Toxinology website (toxinology.com).
Conclusions: *Bothriechis spp.* envenomations are rarely reported in the literature. Treatment with crotalidae immune F(ab')$_2$ (equine) antivenom was associated with improvement in hemodynamics and coagulation parameters in this case

KEYWORDS Bothriechis envenomation; antivenom; snake envenomation

semple@wustl.edu

233. Carburetor cleaner exposures treated at emergency departments

Salvador Baeza[a] and Mathias Forrester[b]

[a]West Texas Regional Poison Center, El Paso, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Carburetor cleaner or degreaser products typically contain methanol and hydrocarbons such as toluene, propane, and isobutene. Exposure to carburetor cleaner may result in such adverse effects as neurotoxicity (e.g., lethargy, ataxia, coma), vomiting, metabolic acidosis, blindness, and death. The objective of this study was to describe carburetor cleaner exposures managed at US (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. National estimates are calculated from the database records based on the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. To identify carburetor cleaner exposures reported during 2000–2020, records with the letter combinations "carb" along with "clean," "fluid," or "gre" in the record narrative were reviewed, and those that appeared to be carburetor cleaner exposures were included in the study. The distribution of carburetor cleaner exposures was determined for various factors. (Due to the small number of cases, national estimates were not calculated.)
Results: A total of 107 carburetor cleaner exposures were identified. There were 61 (57.0%) exposures during 2000–2006, 22 (20.6%) during 2007–2013, and 24 (22.4%) during 2014–2020. Twenty-one (19.6%) exposures occurred in December-February, 24 (22.4%) in March-May, 37 (34.6%) in June-August, and 25 (23.4%) in September-November. The patient age distribution was 17 (15.9%) 0–5 years, 1 (0.9%) 6–12 years, 21 (19.6%) 13–19 years, 14 (13.1%) 20–29 years, 23 (21.5%) 30–39 years, 17 (15.9%) 40–49 years, 9 (8.4%) 50–59 years, 3 (2.8%) 60–69 years, and 2 (1.9%) 70 years and older; the mean age was 29 years (range 1–76 years). Ninety (84.1%) of the patients were male and 17 (15.9%) female. The patient race was 44 (41.1%) white, 6 (5.6%) black/African American, 1 (0.9%) Asian, 19 (17.8%) other, and 37 (34.6%) not stated. The route of the exposure was 59 (55.1%) ocular, 34 (31.8%) inhalation, 7 (6.5%) ingestion, 6 (5.6%) dermal, and 2 (1.9%) otic. Abuse of the carburetor cleaner was documented in 29 (27.1%) of the exposures. The location of the incident was 58 (54.2%) home, 4 (3.7%) street or highway, 3 (2.8%) other public property, 1 (0.9%) school, 1 (0.9%) place of recreation or sports, and 40 (37.4%) not recorded. The most frequently documented clinical effects were 25 (23.4%) conjunctivitis, 23 (21.5%) chemical burn, 5 (4.7%) ocular irritation/pain, 4 (3.7%) anoxia, and 3 (2.8%) hallucinations. The patient disposition was 96 (89.7%) treated or examined and released, 7 (6.5%) treated and admitted for hospitalization, 2 (1.9%) treated and transferred to another hospital, and 2 (1.9%) held for observation.
Conclusions: Carburetor cleaner exposures treated in EDs declined during the study period. Over 70% of the patients were age 13–49 years, and the majority were male. Most of the exposures occurred by ocular followed by inhalation routes. Over half of the exposures occurred at home. Most patients were treated or evaluated and released from the ED.

KEYWORDS Carburetor cleaner; exposures; emergency department

sbaeza@umcelpaso.org

234. Accidental prolonged aerosol exposure to 1.5% glycine solution via inhalation

Erin M Pallasch[a], Marit Tweet[b] and Jerrold Leikin[c]

[a]Illinois Poison Center, Chicago, IL, USA; [b]Southern Illinois University School of Medicine, Springfield, IL, USA; [c]Toxikon Consortium, Chicago, IL, USA

Background: Glycine is an endogenous, non-essential, simple amino acid produced in the human body. A 1.5% solution is commonly used for irrigation in gynecologic and urologic procedures as it is a sterile, clear, non-irritating liquid. It is neutral, mildly acidic and nonpyrogenic, and as it is produced by the human body it does not cause allergic reactions. If an excessive amount is absorbed during a procedure it can result in electrolyte abnormalities, such as hyponatremia or hypocalcemia. It can also result in transient vision disturbances, changes in heart rate, hypotension, hyperammonemia, or encephalopathy. Glycine has been used as a diluent in certain inhaled therapies for COVID-19 infections, such as epoprostenol. We describe a case where a 1.5% glycine solution was inadvertently used for humidified oxygen via high flow nasal cannula as opposed to distilled water.
Case report: The patient was a 70-year-old male who was admitted to the hospital for hypoxia related to a COVID-19 infection with O_2 saturations in the 70–80% range. He was placed on high flow nasal cannula to improve his oxygen levels. During his inpatient stay it was discovered that a 3-L bag of 1.5% glycine solution had been connected to the high flow nasal cannula instead of distilled water. This ran from Friday evening to the following Monday morning before the error was discovered. There was only 100 mL of the glycine solution remaining in the bag when it was found. The patient continued to do well and had no new complaints during his stay. The case was called to the regional poison center which recommended monitoring electrolytes, watching for any possible respiratory symptoms and continuing supportive care. Initial lab work on admission showed a chemistry panel of Na 146, K 3.6, Cl 102, CO_2 25.3, BUN 9, Cr 0.70, Glucose 106, Ca 9.3. Repeat lab work immediately after the mistake was found showed: Na 137, K 4.8 Cl 100, CO_2 28, BUN 15, Cr 0.70, Glucose 129, Ca 9.0. On recommendations from poison control, electrolytes were monitored with repeat lab work 10 h after discontinuation of the glycine solution, showing: Na 135, K 4.3, Cl 97, CO_2 26.8, Glucose 175, Ca 9.2. The patient did not develop any new complaints, had no reported altered mental status, epistaxis, nasal irritation or other symptoms related to the inhalation. He was eventually discharged home on oxygen for his persistent hypoxia related to his COVID-19 lung infection.
Discussion: This case demonstrates that prolonged continuous inhalational exposure to a 1.5% glycine irrigation solution does not result in any mucosal irritation, metabolic or systemic toxic reactions, even though its pH is reportedly between 4.5 and 6.5. Thus, glycine solutions up to this concentration appear to be safely tolerated for its increasing use as an excipient for aerosolized medications.
Conclusions: We describe a case where 1.5% glycine solution was inadvertently used in place of distilled water for humidified oxygen via high flow nasal cannula for approximately 3 days in a patient being treated for COVID-19 related pneumonia with no notable adverse effects.

KEYWORDS Glycine; inhalation; accidental

epallasch@team-iha.org

235. Wait and seed: intentional ingestion of nerium oleander seeds in a non-endemic area

Anita Farris, Lisa Oller, Elizabeth Silver and Stephen Thornton

Kansas Poison Center at the University of Kansas Health System, Kansas City, KS, USA

Background: *Nerium oleander* is an evergreen shrub in the dogbane family, *Apoycynaceae*. All parts of the plant contain cardiac glycosides with oleandrin being the most relevant. Toxicity results from the inactivation of Na^+/K^+ ATP-ase and the increase in extracellular potassium (K^+), not only at the cardiac cell but in other parts of the body. Toxicity is comparable to digoxin with gastrointestinal, neurological, and cardiovascular effects. Intentional self-harm with Nerium oleander is well described in endemic areas, such as Southeast Asia, but uncommon in other parts of the world. We report a case of a non-endemic, intentional ingestion of "hot pink oleander seeds" obtained via an online source resulting in bradycardia and measurable digoxin levels.
Case report: A 31-year-old male with a history of suicide attempts arrived in the emergency department approximately 5 h after intentional ingestion of 60 "hot pink oleander seeds," purchased online. He was alert and oriented and had a blood pressure of 149/106 mmHg, pulse 121 bpm, respirations 18/min, and oxygen saturation of 95% on room air. Electrocardiogram initially showed normal sinus rhythm, but his pulse began to fluctuate between bradycardia and tachycardia. Acetaminophen was undetectable, salicylate level 2.3 mg/dL and alcohol 25.0 mg/dL. Initial digoxin level was 0.51 ng/mL, K^+ 3.2 mmol/L, and creatinine 0.9 mg/dL. Due to concern the seeds could cause prolonged absorption, activated charcoal 50 g and whole bowel irrigation (WBI) were initiated, though only a portion of the WBI was administered. He was admitted for monitoring and serial labs. Serial digoxin levels were 0.99 ng/mL, 1.06 ng/mL and 0.85 ng/mL, with the peak approximately 29 h post-ingestion. He remained bradycardic, with lowest heart rate of 42 reported 30 h post-ingestion. He never developed an elevated K^+ or required treatment with digoxin immune FAB. He was discharged 48 h after ingestion with a heart rate of 65.
Discussion: Intentional self-harm with *Nerium oleander* is rare in the US, likely due to lack of public knowledge regarding toxicity and the availability of the plant. In this case, the patient was in an area where *Nerium oleander* does not naturally grow. This patient ordered "Hot Pink Oleander Seeds" from a mainstream online source, specifically to commit suicide. It was unknown if the seeds were crushed or chewed, which could affect absorption and toxicity, therefore gastrointestinal decontamination was recommended to prevent on-going absorption. It is known that non-digoxin cardiac glycosides, like those found in *Nerium oleander*, will unpredictably react with standard digoxin assays. Our patient had measurable digoxin levels with a delayed peak that coincided with his lowest heart rate. Fortunately, he experienced only bradycardia and did not require digoxin immune FAB which has been described to inefficiently neutralize non-digoxin cardiac glycosides.
Conclusions: This case demonstrates the availability via online sources of toxic substances that otherwise may not be endemic or regionally common such as *Nerium oleander* and the need for health care professionals to have an approach for these unique ingestions. Specific to *Nerium oleander* ingestions, a prolonged observation period and the use of gastrointestinal decontamination are important factors to consider.

KEYWORDS Oleander; intentional; activated charcoal

afarris@kumc.edu

236. Uterine atony due to ingestion of *Montanoa tomentosa* Cerv.

Rocío Martiñón Ríos[a], Jorge Guillermo Pérez Tuñón[a], Jerónimo Quezada Colín[b], Natanael del Angel Gonzalez[c] and Arturo Giovanny Ponce de Leon[d]

[a]Centro Toxicológico Hospital Angeles Lomas, Mexico City, Mexico; [b]IMSS bienestar, Mexico City, Mexico; [c]Hospital Angeles Lomas, Huixquilucan, Mexico; [d]Centro Tóxicologico Hospital Ángeles Lomas, Estado de México, México

Background: Several extracts prepared from the roots of the native mexican shrub Zoapatle (*Montanoa tomentosa Cerv*), are used as oxytocic to induce labor and treat postpartum hemorrhage. *Montanoa tomentosa* Cerv., also called "Cihuapatli," "To" or "Roo-ó-toó," represents an ancient remedy that is widely used in some rural areas of Mexico, where it has been linked to obstetric complications in both the mother and the newborn. We present the case of a patient who developed uterine atony and postpartum hemorrhage associated with the consumption of an infusion of *M. tormentosa* Cerv.
Case report: A 17-year-old female (G1P0) at 40 + 5/7 weeks gestation presented to the hospital during the first stage of labor, although because she underwent a rapid evolution, she reached the expulsive period in less than 2 h. A female newborn was obtained with a weight of 3.24 kg (7.15 pounds) and Apgar score of 9/9. As a result of childbirth, the mother suffered lacerations to the cervix and uterine atony that caused significant bleeding, for which she was treated with ergonovine, carbetocin, crystalloids and two units of blood, until the hemorrhage was controlled. 48 h later, the binomial was discharged without complications, however, 4 days later mother was readmitted due to vaginal bleeding. The patient reported that the vaginal bleeding began 40 min after drinking a cup of Zoapatle tea, which she had also drank to induce labor 1 week ago. In the new event, the total blood loss was estimated at 2000 mL and pharmacological treatment was unsuccessful, so a hysterectomy was performed and another 3 units of blood were administered. Finally, he was discharged again after 4 days without complications.
Discussion: The roots of *M. tomentosa* Cerv. contains grandiflorenic acid and a triplet of oxepane diterpenoids (zoapatanol, montanol and tomentol), whose biological actions appear to be similar to those produced by oxytocin, increasing spontaneous uterotonic activity and predisposing to complications such as those presented by our patient. Traditionally, many women use these herbal products for childbirth and do not tell their obstetrician. Therefore, it is important to provide information to pregnant women of their clinical effects and possible complications of it use, likewise, during admission to the labor room, it is necessary to question the patient about the consumption of this and other traditional remedies in order to initiate a better and timely treatment.

KEYWORDS Montanoa tormentosa Cerv.; uterine atony; obstetric hemorrhage

chiomartinonrios@gmail.com

237. Chronic methanol toxicity through topical and inhalational routes presenting as vision loss

Wenceslao Kiat and Mojica Christianne

St. Luke's Medical Center, Quezon City, Philippines

Background: Methanol intoxication can cause irreversible neurologic sequelae if unrecognized and untreated. Ingestion is the most common form of toxicity; however, dermal and inhalational exposures likewise occur but are documented rarely. While acute intoxication is commonly encountered, chronic exposure to methanol should also be highlighted. We report a case of a 57-year-old female who presented in the emergency room with progressive dyspnea, metabolic acidosis with high anion gap, and metabolic encephalopathy.
Case report: After emergency hemodialysis, the patient complained of vision loss on both eyes. Initial non-contrast cranial magnetic resonance imaging (MRI) revealed restricted diffusion of the intraorbital segment of both optic nerves. A thorough history revealed that she was applying a clear colorless liquid bought online all over her body for alleged pruritus for more than a year. The syndrome of metabolic acidosis with high anion gap, metabolic encephalopathy, vision loss, and laboratory findings led us to suspect a diagnosis of chronic methanol poisoning with an acute component. The liquid in question was sent for chemical analysis and result showed that it consisted of 95.5% Methanol.
Conclusions: This case highlights the need for high index of clinical suspicion for methanol toxicity in the absence of oral consumption, the complications of chronic form of methanol intoxication, and the uncommon radiologic finding seen in diffusion-weighted imaging (DWI).

KEYWORDS Methanol; chronic intoxication; loss of vision

wencykiat@yahoo.com

238. Pediatric lighter fluid exposures reported to poison centers

Brett Roth[a], Thi Nguyen[a], Enrique Robles[a] and Mathias Forrester[b]

[a]North Texas Poison Center and UT Southwestern, Dallas, TX, USA; [b]Independent Researcher, Austin, TX, USA

Background: Lighter fluid is a flammable liquid hydrocarbon found in cigarette lighters and other types of lighters. Some of the hydrocarbons included in lighter fluids are benzene, butane, hexamine, lacolene, naptha, and propane. Exposure to lighter fluid may occur through ingestion, inhalation, aspiration, dermal, or ocular routes. Lighter fluid exposures may result in oropharyngeal irritation or pain, loss of vision, abdominal pain, nausea, vomiting, chemical burns, breathing difficulty, chest pain, cough, hypotension, confusion, dizziness, drowsiness, hallucinations, headache, insomnia, irritability, tremor, ataxia, seizures, vision loss, and coma. The objective of this study was to characterize pediatric lighter fluid exposures reported to poison centers.
Methods: Cases were lighter fluid exposures involving patients age 0–5 years reported to a statewide poison center system during 2000–2020. Exposures involving other substances in addition to lighter fluid and exposures not followed to a final medical outcome were included. The distribution of the cases was determined for various factors related to patient demographics, exposure circumstances, management, and outcome.
Results: A total of 3296 pediatric lighter fluid exposures were identified. The patient age distribution was 131 (4.0%) 0 years, 1636 (49.6%) 1 year, 1123 (34.1%) 2 years, 256 (7.8%) 3 years, 92 (2.8%) 4 years, 43 (1.3%) 5 years, and 15 (0.5%) unknown age; 2043 (62.0%) of the patients were male, 1230 (37.3%) female, and 23 (0.7%) unknown sex. The exposure route was 3047 (92.4%) ingestion, 485 (14.7%) dermal, 175 (5.3%) aspiration, 78 (2.4%) ocular, 42 (1.3%) inhalation, 5 (0.2%) otic, and 2 (0.1%) other/unknown. The exposures were 3285 (99.7%) unintentional,

1 (0.0%) intentional, 7 (0.2%) other, and 3 (0.1%) unknown. Most ($n = 3167$, 96.1%) of the exposures occurred at the patient's own residence, 95 (2.9%) at another residence, and 34 (1.0%) at other/unknown locations. The management site was 1550 (47.0%) on site, 1258 (38.2%) already at or en route to a healthcare facility, 452 (13.7%) referred to a healthcare facility, and 36 (1.1%) at other/unknown locations. The medical outcome was 921 (27.9%) no effect, 961 (29.2%) minor effect, 320 (9.7%) moderate effect, 43 (1.3%) major effect, 93 (2.8%) not followed-judged nontoxic, 627 (19.0%) not followed-minimal clinical effects possible, 289 (8.8%) unable to follow-potentially toxic, and 41 (1.2%) unrelated effect; 1 death was reported. Of the cases involving aspiration, 15 (8.6%) had no effect, 66 (37.7%) minor effect, 51 (29.1%) moderate effect, 9 (5.1%) major effect, 1 (0.6%) not followed-minimal clinical effects possible, 31 (17.7%) unable to follow-potentially toxic, and 1 (0.6%) unrelated effect; 1 death was reported. The most frequently reported clinical effects were cough/choke ($n = 1232$, 37.4%), vomiting ($n = 559$, 17.0%), fever/hyperthermia ($n = 154$, 4.7%), positive X-ray findings ($n = 149$, 4.5%), and drowsiness/lethargy ($n = 95$, 2.9%). The most common treatments were dilute/irrigate/wash ($n = 2056$, 62.4%), food/snack ($n = 252$, 7.6%), and oxygen ($n = 179$, 5.4%).
Conclusions: Most pediatric lighter fluid exposures involved patients age 1–2 years and the majority were male. Most of the exposures were unintentional, occurred at a home, and occurred by ingestion. Almost half of the exposures were managed outside of a healthcare facility. Exposures involving aspiration had more serious outcomes.

KEYWORDS Lighter fluid; pediatric; poison centers

Brett.roth@utsouthwestern.edu

239. You dropped the bomb on me – a case series of carbon tetrachloride toxicity

Derek Fikse, Amanda Stashin, Scott Wheatley, Kenneth Katz and Andrew Koons

Lehigh Valley Health Network/USF Morsani College of Medicine, Allentown, PA, USA

Background: Carbon tetrachloride (CCl4) is a halogenated hydrocarbon previously used in dry cleaning agents, refrigerants, and fire extinguishers. CCl4 toxicity is rarely observed. Two patients with acute hepatitis following exposure to a CCl4-containing antique fire extinguisher are presented.
Case series: A son (patient one) and father (patient two) were both admitted to the hospital with acute, unexplained transaminitis. After extensive questioning, they reported recent exposure to a large amount of CCl4 when an antique "fire bomb" shattered on the floor of their home. Both patients not only cleaned the debris without personal protective equipment, but also slept in the contaminated area. Patient one had a peak AST 3386 U/L (<41) and ALT 2968 U/L (<56). Patient two had a peak AST 18,203 U/L and ALT 8572 U/L. Both patients received intravenous N-acetylcysteine; patient one also received oral cimetidine. Both patients recovered uneventfully without sequelae. Extensive work-up for other causes of transaminitis was unremarkable. Serum analyses for CCl4 was also unremarkable due to delay between the exposure and hospital presentation.
Discussion: CCl4 is a potent hepatotoxin. CCl4 metabolism via cytochrome CYP2E1 produces its toxic metabolite, the trichloromethyl radical. This radical covalently binds to hepatocyte macromolecules and causes lipid peroxidation and oxidative damage with ensuing centrilobular necrosis. Treatment is not well established but N-acetylcysteine is likely beneficial via glutathione repletion and antioxidant effects. Cimetidine blocks cytochrome P450, and thus metabolite formation. Cimetidine may also promote stimulation of regenerative processes acting on DNA synthesis.
Conclusions: CCl4 toxicity is rare and infrequently reported in current literature but should be maintained in the differential of acute hepatitis. That two patients presented nearly identically-especially at two different ages but from the same household-offered a clue to this enigmatic diagnosis.

KEYWORDS Carbon tetrachloride; hepatotoxin; transaminitis

Derek.Fikse@lvhn.org

240. Toxicity from the NPS N-methyl-cyclazodone with laboratory confirmation – a dance befitting St. Vitus

Jack Basile[a], Joan Nolan[b], Alex Krotulski[c] and Kevin Osterhoudt[b]

[a]Penn State Health, Reading, PA, USA; [b]Poison Control Center at Children's Hospital of Philadelphia, Philadelphia, PA, USA; [c]The Center for Forensic Science Research and Education, Willow Grove, PA, USA

Background: Stimulants and purported nootropic, or "smart drug" chemicals, that are not internationally controlled, comprise part of a wide range of drug analogs that are collectively regarded by the clinical toxicology community as Novel Psychoactive Substances (NPS). We report clinical features of a case of self-administration of a particular stimulant NPS, N-methyl-cyclazodone, to add to the establishment of its toxicological profile.
Case report: A 38-year-old man sought evaluation for uncontrollable body movements and palpitations. He reported that he had been self-treating his attention deficit disorder for 5 days with N-methyl-cyclazodone; he purchased "pure" powder online and had consumed a total of ~5 g mixed in water. He also had prescriptions for fluoxetine and aripiprazole for bipolar disorder. The man was noted to be inattentive, restless, tremulous, and to have choreiform movements of his entire body. His heart rate was 110/min, blood pressure 150/90 mmHg, and respiratory rate 24/min. His pupils were dilated but reactive to light. An ECG displayed sinus tachycardia with QRS interval 140 ms and QTc 526 ms. A urine drug immunoassay was negative for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates and phencyclidine; serum ethanol testing was negative. He was given IV crystalloid to achieve vascular euvolemia, and lorazepam for his movement disorder and autonomic hyperactivity; two ampules of sodium bicarbonate were given with shortening of the widened QRS, and magnesium was supplemented. Serum chemistries were notable for a creatine kinase (CK) of 2954U/L and an alanine aminotransferase (ALT) of 104 U/L; creatinine was normal. With supportive care his symptoms resolved by hospital day 3 and his serum CK and ALT was trending downward. Liquid chromatography high resolution mass spectrometry testing confirmed the drug cyclazodone, an expected metabolite of N-methyl-cyclazodone, in the urine. No unexpected drugs were identified in the sample; specifically, no pemoline or 4-methylaminorex were found.
Discussion: The oxazolidine derivative cylazodone is a centrally acting dopaminergic stimulant drug. It was developed in the 1960s and has chemical similarity to pemoline and aminorex, and it appeared in the online research chemical market in 2017. Cyclazodone is not currently approved by the US Food and Drug Administration; despite its online sale and the presence of online testimonials of human consumption little is documented

regarding its observed toxic effects. Cyclazodone use appears uncommon as it was not listed in the 2022-Quarter 1 NPS Stimulants Trend Report of the Center for Forensic Science Research and Education. The related drug pemoline became a schedule IV controlled substance in the US after clinical reports of associated liver damage in children. Pemoline toxicity has also been associated with choreoathetosis and rhabdomyolysis.
Conclusions: We present a case of user-reported N-methyl-cyclazodone use, with laboratory confirmation of cyclazodone, remarkable for associated hyperadrenergic vital signs, choreoathetoid movements, sodium bicarbonate-responsive QRS interval prolongation, and rhabdomyolysis with hepatic aminotransferase elevation. Contribution from, or interaction with, prescribed fluoxetine or aripiprazole cannot be excluded, but the toxic syndrome witnessed with cyclazodone was similar to toxicity described with the related drug pemoline.

KEYWORDS Cyclazodone; novel psychoactive substance; chorea

cyclingdoc@gmail.com

241. Unintentional pediatric lithium exposure: a 15-year retrospective analysis of cases reported to the California Poison Control System

Justin Seltzer[a], Nate Friedman[a], Garret Winkler[a], Daniel Lasoff[a] and Lee Cantrell[b]

[a]UC San Diego Health, VA San Diego Health Care, San Diego, CA, USA; [b]CPCS – San Diego, San Diego, CA, USA

Background: Lithium is among the most common pediatric psychotropic medication exposures, with approximately 5600 cases reported to US Poison Centers from 2009 to 2018. While the effects of acute overdoses are well characterized in adults, they are not for pediatric accidental or exploratory ingestions. To date, only one study has examined pediatric exploratory lithium ingestions; it was limited to children less than 6 years old and did not include serum concentrations.
Methods: A Poison Control System database was queried for pediatric lithium exposures between January 2006 and December 2021. Inclusion criteria included age 16 years or younger and acute lithium ingestion treated in a healthcare facility. All unintentional exposures, including licked/chewed pills and possible/known missing or spilled pills were included. Ages over 16 years, non-oral exposures, intentional, chronic, or non-lithium exposures were excluded.
Results: Of 737 cases examined, 118 were included and 619 (316 intentional, 151 over 16 years, 113 chronic, 32 undifferentiated/unclear exposures, 5 non-lithium, and 2 from out-of-state) were excluded. The median age was 2 years (range 0.5–15 years); 93 (79%) were 2 or younger, 22 (19%) between 3 and 7, and 3 (2%) older than 7 years. 68 (57.6%) were male. 113 (95.8%) were exploratory ingestions; 5 (6, 7, 10, 11, and 15 years old) had accidentally taken/been given another's medication. 94 (80%) were exposed to lithium carbonate, two to lithium orotate, and for 22 (19%) formulation was not recorded. 70 cases exposed to lithium carbonate had a possible dose recorded, with a median of 525 mg (range 100 mg-13500 mg). 67 had serum lithium concentrations drawn: 19 (28%) were detectable (>0.1 mEq/L) and 4 were above 1.2 mEq/L, the upper limit of normal. Only one supratherapeutic concentration was symptomatic – a 2-year-old with "ataxia, delirium, and agitation" following ingestion of lithium carbonate, trazodone, oxycodone, acetaminophen, ibuprofen, and metoprolol. The peak lithium concentration was 3.87 mEq/L. The patient recovered following IV fluid administration. Thirteen (11%) were admitted, three to the ICU. Thirteen received IV fluids and three received whole bowel irrigation. No morbidity or mortality were reported. In total, 100 (85%) were coded as having no effects, 4 (3%) as having effects (one mild, two moderate, and one major), and 14 (12%) were lost to follow-up. The major effects case was a 1-year-old with CNS depression following a lithium carbonate and quetiapine co-ingestion who recovered after IV fluids and whole bowel irrigation. The moderate effects cases were the aforementioned 2-year-old and a 3-year-old with ataxia and unsteady gait following a lithium carbonate, doxepin, and naproxen co-ingestion who recovered without intervention. The mild effects case was a 3-year-old who was "groggy" following a lithium carbonate and clonazepam co-ingestion and recovered without intervention.
Conclusions: The majority of unintentional pediatric lithium ingestions are exploratory and result in no significant symptoms. 28% of measured serum lithium concentrations were detectable and only one developed significant symptoms.

KEYWORDS Lithium; pediatric; accidental

jseltzer@gmail.com

242. Myocarditis induced by immune checkpoint inhibitor therapy

Muhammad Akbar Baig, Wells Brambl and William Heuser

NorthShore University Health System, Manhasset, NY, USA

Background: Tumor cells express high levels of Programmed Death Ligand-1 (PDL-1), which interacts with Programmed Death-1 (PD-1) and is expressed on the surface of CD8+ T cells. This positive interaction decreases T-cell cytotoxicity, thereby preventing CD8+ T-cell-mediated programmed death of cancer cells. Nivolumab is a monoclonal antibody that binds PD-1 and blocks PD-1/PD-L1 interaction, which enhances T-cell cytotoxicity and facilitates the elimination of tumor cells. Of clinical importance, enhanced CD8+ T cell activity can lead to autoreactivity against normal body tissues.
Case report: An 86-year-old male presented to the emergency department with complaints of lethargy and gait instability for a month that progressed in last 2 days. He underwent a left nephroureterectomy 2 months ago, however he had residual high grade urothelial cancer of the left distal ureter for which he received the first dose of Nivolumab a month prior. He was hemodynamically stable and physical exam was normal. Electrocardiogram (EKG) showed atrial sensed ventricular paced rhythm. Labs showed an elevated Troponin T of 1235 ng/L and creatine kinase of 2950 U/L. The patient was hospitalized, and an echocardiogram (ECHO) showed no wall motion abnormalities. After specialist consultation, it was deemed that patient had Nivolumab induced myocarditis and stress dose steroids were initiated. After 5 days of hospital stay, patient developed hypoxemic respiratory failure secondary to pnuemonitis which gradually improved after oxygen delivery and steroid therapy. Following stabilization, a cardiac MRI was performed which showed no delayed myocardial enhancement. Patient was discharged on combination of mycophenolate mofetil and steroids.
Discussion: Myocarditisis a rare but lethal complication, which can result in refractory cardiogenic shock, congestive heart failure, and deadly arrhythmias. The incidence of ICI-associated myocarditis can range from 0.1% to 1% with a case fatality rate of 25–50%. Diagnosis of ICI-associated myocarditis requires EKG, cardiac enzymes and ECHO. The current gold standard test is the cardiac MRI which would show abnormal areas of hyperintensity on delayed contrast enhancement sequences, however, 43% cases can have a normal MRI scan. If required, an invasive endomyocaridal biopsy can be performed which would demonstrate gelatinous lesions on the involved myocardial segments that

under microscopy would reveal lymphocytic inflammation, interstitial edema, necrosis and granulation tissue formation. Treatment of includes stopping ICI therapy and steroid use. In steroid refractory cases, agents such as infliximab, mycophenolate mofetil, andantithymocyte globulin have been utilized with variable success rates.
Conclusions: Our case illustrates a nearly fatal cardiovascular complication of ICIs, necessitating the importance of cardiac surveillance for outpatient usage of nivolumab.

KEYWORDS Nivolumab; immune checkpoint inhibitor; myocarditis
MBaig5@northwell.edu

243. The adjunctive use of plasmapheresis after severe amlodipine overdose

James Infanzon, Mohan Punja and Richard Kleiman
Wellstar Kennestone Regional Medical Center GME, Marietta, GA, USA

Background: Amlodipine is a commonly prescribed calcium channel blocking anti-hypertensive agent that can have serious effects when taken in large amounts. These effects include shock and hypotension requiring high doses of vasoactive medication to maintain adequate perfusion and in severe cases, extracorporeal life support such as VA-ECMO (veno-arterial extracorporeal membrane oxygenation). Hypothesis: Plasmapheresis after amlodipine overdose may reduce vasopressor requirements and shorten the duration of extracorporeal life support. This is a single patient chart review.
Case report: A 40-year-old woman presented to the Emergency Department with nausea and vomiting. During initial evaluation in the Emergency Department, the patient was found to be severely hypotensive. She developed cardiogenic shock over the next few hours and was later found to have ingested 80–90 tablets of 10mg amlodipine. On day 1 of admission, vasopressor requirement escalated to include norepinephrine, vasopressin, epinephrine, phenylephrine and angiotensin II. Continuous Renal Replacement Therapy (CRRT) was initiated, the patient was given a dose of lipid emulsion, methylene blue and a continuous infusion of high dose insulin. The patient was transferred to an ECMO center early on day 2 of admission. On arrival, the patient was intubated and VA-ECMO was initiated. An amlodipine level was drawn after ECMO cannulation and found to be 99 ng/mL. The therapeutic range for amlodipine, per the Mayo Clinic Laboratories reference, is 2–25 ng/mL. Due to persistent hypotension, the decision was made to initiate plasmapheresis on admission day 2. Amlodipine levels drawn after the first administration of plasmapheresis was 79 ng/mL. On admission day 4, amlodipine levels measured 89ng/mL prior to plasmapheresis and 36 ng/mL after plasmapheresis. On admission day 5, prior to plasmapheresis the amlodipine level was measured at 79 ng/mL and 40 ng/mL after plasmapheresis. The patient was decannulated from ECMO on admission day 7 with no vasopressor requirement. CRRT was discontinued on the same day. The patient was extubated on admission day 9 and deemed stable for transfer out of the ICU on admission day 11. On admission day 19, the patient was discharged from the hospital. Diagnosis: Distributive and cardiogenic shock secondary to acute amlodipine toxicity.
Discussion: Standard treatment measures for amlodipine overdose include vasopressors, intralipid emulsion, and high-dose insulin. In refractory cases, the use of extracorporeal life support may be required. Given the highly protein-bound nature of amlodipine, plasmapheresis may be used to facilitate the removal of the offending agent to reduce continued toxicity in addition to the above supportive measures. Previous studies in amlodipine use and toxicity have found therapeutic levels achieved with 10mg daily dosing to be less than 10 ng/mL.
Conclusions: Plasmapheresis may be an effective adjunctive therapy in the treatment of severe distributive and cardiogenic shock occurring in the overdose of anti-hypertensive agents such as amlodipine. Further study will be needed to determine the specific benefit of plasmapheresis when compared to other therapies. Disclosure Statement The authors report no potential conflict of interest.

KEYWORDS Amlodipine; plasmapheresis; ECMO
j.infanzon@gmail.com

244. Pyroglutamic acidosis triggered by valproic acid-induced pancreatitis

Chitbhanu Singh[a], Wesley Palatnick[b], Milton Tenenbein[b] and Aaron Guinn[a]
[a]University of Manitoba, Winnipeg, Canada; [b]Health Sciences Centre, Winnipeg, Canada

Background: Acquired pyroglutamic acidosis is a described complication of chronic acetaminophen use. We describe a case of a 54-year-old female with acquired pyroglutamic acidosis secondary to acute valproic acid induced pancreatitis associated with chronic acetaminophen usage and adalimumab-induced interstitial lung disease.
Case report: A 54-year-old woman presented to the hospital with a two-day history of severe abdominal pain, nausea, and confusion. She had a several month prodrome of anorexia, weight loss, and respiratory symptoms. There was no history of alcohol usage or intentional overdose. Her medical history was significant for rheumatoid arthritis, for which she took adalimumab and acetaminophen with codeine, and bipolar disorder on valproic acid. Bloodwork demonstrated a venous pH of 7.06 with an anion gap of 31, as well as an elevated lipase. Abdominal imaging was consistent with pancreatitis and showed no gallstone disease. Serum lactate, betahydroxybutyrate, and toxic alcohols were all within normal limits. Serum creatinine was 112 μmol/L. Her serum VPA and acetaminophen levels were 12.8 mg/L and 21 mg/L, respectively. Acquired pyroglutamic acidosis was clinically diagnosed and bicarbonate and n-acetyl-cysteine infusions were started with rapid resolution of acidosis. Urine organic acid levels ultimately showed elevated levels of pyroglutamic acid (20,576 mmol/mol Cr; ref range <62), confirming the diagnosis. There were no findings of an underlying infection. Investigations into the etiology of her pancreatitis showed no cause other than her valproic acid, which was stopped with resolution of her pancreatitis. Investigations into her preceding anorexia and respiratory symptoms ultimately led to a diagnosis of adalimumab-induced interstitial lung disease, which rapidly resolved with steroid therapy and stopping adalimumab.
Discussion: Pyroglutamic acidosis in the context of chronic acetaminophen use is well described. The toxic metabolite of acetaminophen, NAPQI, directly depletes glutathione. In the γ-glutamyl cycle, glutathione exerts inhibitory effects on γ-glutamyl-cysteine synthase. In glutathione deplete states (i.e., malnutrition, acetaminophen use), disinhibition of this enzyme favours the generation of pyroglutamic acid, contributing to metabolic acidosis. The pathogenesis of pyroglutamic acidosis in our patient is hypothesized to be due to acute oxidative stress of pancreatitis in the context of baseline glutathione depletion from chronic acetaminophen use and anorexia with resulting malnutrition from her adalimumab-induced interstitial lung disease. To our knowledge, pancreatitis has not been described as a trigger for pyroglutamic acidosis previously. Animal studies examining acute pancreatitis have shown reduced glutathione levels compared to control subjects. Although the mechanism is not fully

elucidated, it is hypothesized to be due to activation of trypsinogen and carboxypeptidase which are involved in glutathione cleavage.
Conclusions: Pyroglutamic acidosis is a rare but likely unrecognized and underdiagnosed condition in hospitalized patients. Given that acetaminophen is readily available, it is critical to have a high index of suspicion for this diagnosis in patients with unexplained anion-gap metabolic acidosis. Non-infectious causes of acute oxidative stress such as pancreatitis, may serve as the trigger in some patients.

KEYWORDS Pyroglutamic acidosis; acetaminophen; pancreatitis
chitbhanu@icloud.com

245. A case of early chelation therapy in a potentially lethal mercuric chloride ingestion

Haley Fox[a], Ryan Feldman[a] and Andrew Farkas[b]
[a]Froedtert and the Medical College of Wisconsin, Milwaukee, WI, USA; [b]Medical College of Wisconsin, Shorewood, WI, USA

Background: Acute ingestion of mercuric chloride can lead to serious and life-threatening events. Symptoms include gastrointestinal corrosion, acute renal failure, and circulatory collapse which can lead to death if not promptly identified and treated. This report details a patient with a potentially fatal ingestion of mercuric chloride who made a full recovery following the early initiation of chelation therapy.
Case report: A 28-year-old, 66.7 kg male reportedly ingested a 50 g bottle of inorganic mercuric chloride in powder form, which he purchased online, for deliberate self-harm. He presented to an Emergency Department via EMS approximately 1-h post-ingestion with nausea, blood-streaked vomiting, throat pain, and abdominal burning. His vital signs were within normal limits and an electrocardiogram demonstrated normal sinus rhythm. Blood biochemistry indices were within normal limits with an initial creatinine of 0.98 mg/dL. An abdominal radiograph was negative for radio-opaque material. Treatment with whole bowel irrigation was deferred given the patients negative abdominal radiograph. Per the guidance of the regional poison control center, intramuscular dimercaprol (BAL) was initiated within 2 h of presentation to the ED and he was admitted to a medical service for monitoring and continued chelation (5 mg/kg every 4 h for 48 h, then 2.5 mg/kg every 6 h for 48 h, then 2.5 mg/kg every 8 h for 48 h, then 2.5 mg/kg every 12 h for 24 h). Esophagogastroduodenoscopy on hospital day (HD) 2 that showed mild hemorrhagic gastritis. His abdominal pain and nausea was managed symptomatically and he was able to tolerate meals by HD2. The patient's symptoms began to improve by HD3. At which point it was recommended that the patient was transitioned to oral succimer on HD3; however, due to availability issues, BAL IM was continued until HD7. The patient made a full recovery and was transferred to a behavioral health facility on HD7 with the following regimen of oral succimer: 10 mg/kg by mouth three times daily for 5 days, then two times daily for 14 days. The initial blood and spot urine mercury concentrations 2 h post-ingestion were 107.8 μg/L and 5061 μg/L, respectively. Mercury blood concentrations were determined daily for three days. He had a 24-h urine mercury of 333 μg/L on HD 3. The apparent half-life of elimination was 24.9 h.
Conclusions: Mercuric chloride is widely available for purchase on the internet. Poisonings, although rare, may be severe or even fatal. Ingestions of 30–50 mg/kg, or 1–4 g, of mercury chloride are potentially lethal and require prompt intervention to avoid severe outcomes. This is a case of a potentially fatal mercuric chloride ingestion with elevated blood mercury levels resulting in only mild symptoms after early chelation with BAL.

KEYWORDS Mercury; inorganic; chelation
haley.fox@froedtert.com

246. Bad brew: a fatal case of *Nerium oleander* tea poisoning

Thom Maciulewicz, Geoffrey Smelski and Steven Dudley
Arizona Poison and Drug Information Center, Tucson, AZ, USA

Background: Plants have been used for several millennia for various health benefits. Consequently, toxicity has ensued resulting in severe morbidity and mortality. *Nerium oleander* is a flowering ornamental shrub found commonly in tropical and subtropical climates, including parts of the US. Cardiac glycosides, specifically oleandrin, are ubiquitous in all parts of the plant and considered toxic with excessive ingestion.
Case report: We report a fatal case of a 58-year-old male with a past medical history of type II diabetes mellitus, hypertension, and a pacemaker who brewed tea with leaves from an oleander plant, intending to treat his diabetes. Two hours after consumption, he presented with repeated bouts of emesis and vitals significant for HR: 152 bpm, BP: 102/89 mmHg, and RR: 33 bpm. Physical exam notable for diaphoresis, foamy oral secretions, pupils 6 mm and reactive, and altered mental status. Stat blood work revealed lactate 2.4 mmol/L, calcium 5.3 mg/dL, and potassium 6.4 mmol/L. EKG showed a wide complex tachycardia with a prolonged QTc (HR 162, QRS 134, QTc 526). The primary team initiated 10 vials of digoxin immune fab (DIF), 3 g calcium gluconate, regular insulin, and dextrose. Toxicology requested another 11 vials (remainder available) be made and ready to be given after the first DIF infusion. The insulin/dextrose infusion was briefly stopped halfway due to complaint of chest pain and emesis. Infusion resumed and shortly after the patient suffered a cardiac arrest. Advanced cardiac life support (ACLS) measures were started and at this time the DIF infusion was accelerated without response. After 6 rounds of compressions and no cardiac activity on ultrasound, time of death was declared within 2 h from arrival.
Discussion: Ingestion of oleander can lead to fatal toxicity, especially, if brewed into liquid preparations. Oleandrin exhibits toxicity similar to digoxin by inhibiting the sodium/potassium ATPase membrane pump resulting in excessive intracellular calcium and myocardial sensitization. Manifestations of toxicity include nausea, emesis, visual disturbances, seizure, electrolyte disturbances and dysrhythmias leading to cardiac arrest. Oleandrin testing is not readily available, however, plant glycosides can cross-react with digoxin assays indicating presence of these glycosides (1.2 ng/mL in our patient). The state laboratory qualitatively confirmed with gas chromatography-mass spectrometry the presence of oleandrin, oleandrigenin, desacetyloleandrin, gitoxigenin and digitoxigenin in the brew. Autopsy report declared cardiac glycoside toxicity as cause of death. Literature supports antidotal use with up to 30 vials of DIF in oleander toxicity. In our case, treatment with DIF may have been insufficient due to the rapid absorption of a brewed preparation and delayed presentation to our health care facility.
Conclusions: Exposure to cardiac glycoside containing plants can cause fatal toxicity especially if brewed into concentrated teas. As such, prompt patient assessment and treatment with DIF, correction of electrolyte abnormities, cardiac monitoring, and ACLS algorithms should be considered to thwart a potentially fatal outcome.

KEYWORDS Oleander; tea; plant
tmack3001@yahoo.com

247. The overdose is coming from inside the hospital! Intentional exposures occurring at healthcare facilities

Matthew Novak and Carol DesLauriers
Illinois Poison Center, IHA, Chicago, IL, USA

Background: Intentional drug overdoses can occur in any environment, however, there is little information characterizing when these overdoses occur at acute Health Care Facilities (HCFs).
Methods: A retrospective review of a Regional Poison Center's (RPC) data were collected from January 1, 2012 to December 31, 2021. All intentional exposures with exposure site coded at a HCF were included. Exposures were excluded if there was no clear documentation in the free text that the exposure occurred at a HCF or if the reason was not actually intentional.
Results: A total of 141 exposures were identified over the 10 year period. The overwhelming majority of exposures occurred at an Acute Care Hospital (135 95.7%) with the remainder at Physicians' Offices (5 3.6%) and an Urgent Care (1 0.7%). Patients ranged from 10 to 84 years old with a mean and median age of 36.86 and 35 years old respectively. 76 (53.9%) of patients were male and 65 (46.1%) were female. The most common symptoms coded were Central Nervous System depression mild 45, hypotension 30, agitation 22, tachycardia 20, confusion 16, CNS depression moderate 8, ataxia 8, nausea 7, vomiting 7, abdominal pain 7, and QTc prolongation 7. The most common therapies administered were Intravenous fluids 33, oxygen 17, benzodiazepines 14, Single Dose Activated Charcoal 13, sedation 9, naloxone 7, dilute/wash/irrigate 6, and intubation 5. This 10 year review of intentional exposures at acute HCFs at one RPC showed major effect outcomes occurred in 5.6% of cases and death in 0.7%. These percentages are notably higher than what was seen in all intentional exposures reported to our regional poison center during the same period, in which major effects occurred in 3.26% of cases and death in 0.3%. This may be due to the fact that these patients had an underlying medical issue that brought them to a HCF in the first place. The vast majority of drug exposures were prescribed medications belonging to the patient and in their possession. Nearly all nondrug exposures were substances already in the HCF the patient had access to.
Conclusions: Patients with intentional drug overdoses at HCF while rare have the potential to develop severe medical outcomes. Healthcare professionals should be cognizant that hospitalized patients with suicidal ideation and/or a history of substance use disorder are at risk of overdosing on medications in their own possession or substances readily available at the HCF.

KEYWORDS Intentional; overdose; healthcare facility

mnovak@team-iha.org

248. Pulmonary palytoxin poisoning on CT imaging

Megan Daniels[a], Edward Siegel[a] and Lauren Murphy[b]
[a]Temple University Hospital, Philadelphia, PA, USA; [b]Temple University, Philadelphia, PA, USA

Background: Palytoxin poisoning is an uncommon exposure in the US, and is most frequently encountered amongst hobbiests and professionals in the aquarium industry. The toxin is produced by the microalgae Ostreopsis as well as the coral Palythoa toxica. Discovered in Hawaii, the name limu-make-o-Hana translates to "seaweed of death from Hana." Palytoxin interrupts Na^+/K^+ ATPase pump, resulting in widespread cellular dysfunction. Persons are at highest risk when cleaning a fish tank housing the coral that produces palytoxin, resulting in cutaneous or inhalational exposure. We present a case of palytoxin inhalational exposure with computed tomography (CT) imaging.
Case report: A 41-year-old male presented to the emergency department (ED) with dyspnea, cough, and wheezing after cleaning his saltwater fish tank. He reported that he maintains Zoanthid corals in his home saltwater fish tank and typically wears personal protective equipment when cleaning the tank. He had taken off his mask directly after using hot water to clean the tank, and quickly developed shortness of breath. He contacted Poison Control and was instructed to take loratadine with initial improvement in his symptoms. He then developed decreased appetite, nausea, and chills. The following day, in addition to these symptoms, he developed a fever of 102.5 °F and an oxygen saturation of 88% measured with an at-home pulse oximeter. He then proceeded to the ED where he was found to be hypoxic to 91% on room air, tachycardic to 120 bpm, hypotensive to 93/70 mmHg, febrile to 100.9 °F and tachypneic at a respiratory rate of 30. Physical exam revealed clear lung sounds. Application of supplemental oxygen at 2 L resulted in improvement in his oxygen saturation and his hypotension and tachycardia responded to intravenous fluids. Significant laboratory results included WBC count of 20.4 with bands of 14%, elevated lactate of 2.4 mmol/L, elevated D-dimer of 0.48 μg/mL and a negative COVID PCR test. CTA thorax revealed patchy ground-glass opacities in the bilateral upper and lower lobes with mosaicism. The patient received doxycycline in addition to broad spectrum antibiotics due to concern for inhalational marine toxicity. He was also started on 60 mg prednisone, inhaled steroids, and bronchodilators for symptomatic treatment, with improvement in his symptoms. During his hospitalization, a respiratory viral panel was negative for common viruses associated with atypical pneumonia including influenza, coronavirus, metapneumovirus, rhinovirus, enterovirus, adenovirus, parainfluenza, bocavirus, *Chlamydophila pneumoniae*, and *Mycoplasma pneumonia*. His dyspnea gradually improved and he was weaned off supplemental oxygen prior to discharge home on hospital day 2.
Discussion: It is unclear what changes are expected on thoracic imaging in patients with inhalational palytoxin exposure. Chest radiographs in two previous cases displayed scattered infiltrates, and a chest CT in another case showed pleural based consolidations. The ground-glass mosaicism suggests that a more diffuse reactive airway process after an inhalational palytoxin insult.
Conclusions: Patients with inhalational palytoxin exposure may be found to have reactive airway symptoms along with ground glass opacities with mosaicism on CT imaging.

KEYWORDS Palytoxin; poisoning; coral

Megdan918@gmail.com

249. Recurrent Kratom-induced hepatotoxicity from herbal tea ingestion: two times isn't a charm

Zachary Schmitz[a], Mark Su[b], Alan Wu[c] and Stephanie Hernández[d]
[a]Department of Emergency Medicine, NYU Langone Perelman, New York, NY, USA; [b]New York City Poison Control Center, Manhasset, NY, USA; [c]University of California San Francisco, San Francisco, CA, USA; [d]Icahn School of Medicine at Mount Sinai, New York, NY, USA

Background: Kratom is an increasingly common herbal supplement containing the alkaloid mitragynine. It has rarely been associated with drug-induced liver injury (DILI) with a median latency of 20.6 days. We report the case of a patient who ingested a kratom-containing herbal product twice and developed hepatotoxicity within three days on both occasions.
Case report: A 31-year-old woman with no significant past medical history presented to the emergency department (ED) with 2 days of abdominal pain, vomiting, and jaundice. She typically drinks three glasses of wine three times weekly. Three days prior, she reported using a kratom-containing tea called "White Maeng Da Kratom® powder" for the first time. Her laboratory studies showed an aspartate-aminotransferase (AST) 348 μ/L (Normal Range (NR) 5–40 μ/L); alanine-aminotransferase (ALT) 677 μ/L (NR 7–56 μ/L); total serum bilirubin, 16.9 mg/dL (NR <1.1 mg/dL); and direct bilirubin 11.4 mg/dL (NR <0.3 mg/dL). During her hospital admission, advanced blood work and imaging studies were unremarkable. Consequently, no clear etiology for her livery injury was identified. She improved after a 21-h course of N-acetylcysteine (NAC) therapy and was discharged home. Three months later, she returned to the ED for similar abdominal pain and vomiting. Two days prior to this presentation, she again reported using the exact same kratom-containing tea product. This was her second time using the tea and only other time since her prior hospital discharge. Her vital signs were all within normal limits but her physical examination showed jaundice and right upper quadrant tenderness. Laboratory studies were significant for an AST 650 μ/L, ALT 420 μ/L; and total serum bilirubin, 5.4 mg/dL. She was admitted to the hospital again for evaluation of her hepatitis and treatment with intravenous NAC therapy. Her second inpatient workup did not reveal an alternative cause of hepatitis. Subsequent mass spectrometry of the tea using a Sciex 5600 liquid chromatograph-high resolution mass spectrometer confirmed the tea to contain 95.6% mitragynine. The patient improved over 2 days and was discharged home.
Discussion: Kratom is a plant-derived compound that contains mitragynine and 7-hydroxymitragynine; the latter compound being a partial agonist at the mu-opioid receptor. The Naranjo score for the link between this patient's kratom ingestion and hepatotoxicity is 8, suggesting a "probable association." Alcoholic hepatitis was a possibility but thought to be unlikely by the hepatology and toxicology teams given the pattern of laboratory markers. Psychosis, seizure, and coma have all been reported following kratom use. DILI has also been reported following kratom use but recurrent cases have not. Additionally, this case is unique given that onset was only 3 days or less following kratom exposure in both occurrences while the previously reported median duration from ingestion to symptoms was 20.6 days. No specific treatment guidelines exist for kratom associated hepatotoxicity and patients have been given NAC, ursodiol, and/or glucocorticoids – though others have successfully been treated supportively.
Conclusions: While seemingly rare, kratom ingestion is a potential cause of DILI. Practitioners should remember to include kratom on their differential diagnosis of drug-induced causes of hepatotoxicity.

KEYWORDS Kratom; hepatotoxicity; recurrent

Zachary.schmitz@nyulangone.org

250. Toxicological observation of clinical exposures in the aquatic niche (OCEAN)

Adiel Aizenberg, Amr Awad and Sarah Watkins
TTUHSC El Paso, El Paso, TX, USA

Background: Aquatic life intersects daily with human life as we consume seafood and partake in inaquatic activities. Texas has over 3000 miles of coastline, and with increasing global consumption of seafood and trade, physicians are bound to encounter aquatic-related exposures. Aquatic toxicology exposure can result in a multitude of clinical manifestations by various routes. The purpose of this epidemiologic study is to determine the significance of aquatic toxicology in Texas. This information will provide insight on the characteristics of aquatic exposures and determine trends significant in Texas.
Methods: We collected data on aquatic exposures uploaded to the National Poison Data System (NPDS) from the Texas Poison Center Network (TPCN). Data from January of 2012 through April of 2022 were collected using keywords "aquatic," "envenomation," "poisoning," and specific species or toxins associated with aquatic life. Information such as demographics, exposure details, diagnosis, treatments, were analyzed.
Results: Salient points will be highlighted here, these figures being a single numerical representation of the data collected and graphically displayed. Data were collected from the years 2012–22 with a peak incidence occurring in 2020 (198 cases) for full years reported. The total number of cases over this time period was 1567, of which 881 (56.22%) were handled on site. The PCC referred the patient to a hospital in 7.91% of cases. 59.35% of calls concerned male patients. Fish stings (21.76%) and coral envenomations (21.19%) were the two largest reasons for a call to TPCN with most calls concerning bites/stings (879 cases), followed by ingestions (578 cases). 13 unique call reasons to the TPCN were expanded upon. These calls encompassed fish stings, coral envenomations, coelenterate stings, scombroidosis, ciguatera, palytoxin, k. brevis exposure, among others. The largest age group reported was 0–5 years (20.86%), followed by 20–29 year olds (14.17%). Many calls resulted in no follow up due to minimal clinical significance expected (37.91%), with a "major effect" occurring in 1.34% of cases. The most recommended course of treatment documented was dilution/irrigation reported in 832 cases, followed by antihistamines, IV fluids, and antibiotics; these categories are not mutually exclusive to single cases. The exposures largely happened in people's homes, accounting for 66.24% of calls. Dermal irritation and puncture wounds/stings were the most frequent effects reported. There was a clear temporal correlation with most calls occurring during the summer months.
Conclusions: Although Texas has a large coastline, the majority of exposures occurred at home. The data shows that many of these exposures were able to be handled at home by means of simple supportive care. This lends support to the vital function regional poison centers have in managing exposure and delineating healthcare outcomes. These trends can provide education to healthcare providers regarding various trends and manifestations concerning the breadth of toxicological aquatic exposures. Further investigation is necessary to see if these trends hold nationwide and to further focus medical decision making regarding aquatic exposures.

KEYWORDS Aquatic; toxicological; exposure

adiel.aiz@gmail.com

251. Challenges in diagnosing an environmental cause of recurrent methemoglobinemia

Leanne Cook and Michael Levine
Department of Emergency Medicine, UCLA Medical Center, Los Angeles, CA, USA

Background: Methemoglobinemia is caused by excess oxidation of hemoglobin by exogenous substances (acquired) or the impaired reduction of methemoglobin due to hereditary abnormalities

(congenital). The decreased oxygen-binding capacity of methemoglobin can lead to hypoxia, cyanosis, hemodynamic instability, coma and death. Notable exogenous oxidizing agents include topical anesthetics, nitrates and nitrites, dapsone, arsine gas, and some antimalarial drugs. Environmental screening tests may focus on nitrate- or nitrite-contaminated water supplies, but diagnosis is otherwise based on clinical history and genetic testing.

Case report: A 42-year-old female with a history of attention deficit disorder, nephrolithiasis, and 1.5 years of recurrent laboratory-confirmed methemoglobinemia of unknown etiology presented with 1 week of shortness of breath, cyanosis and vomiting. The patient had been previously evaluated by pulmonology and hematology with normal echocardiography, ventilation/perfusion (V/Q) scan, hemoglobin electrophoresis, cytochrome B5 reductase levels and glucose-6-phosphate dehydrogenase (G-6-PD) levels. Episodes resolved with supplemental oxygen. Early evaluations did not provide strong evidence for any particular environmental agent, though a hydroquinone-containing cream and prescription D-amphetamine were considered and ruled out. Symptoms persisted despite initiation of oral methylene blue and supplemental ascorbic acid (vitamin C). Oxygen saturation was 82–85% on room air and improved with nasal cannula oxygen at 2–3 L/min. Vital signs were otherwise within normal limits. Blood chemistries, complete blood count, B-natriuretic peptide, troponin, D-dimer, chest x-ray and CT chest were normal. Arterial blood gas was collected with PaO2 of 136 mmHg. Venous co-oximetry demonstrated methemoblobin levels of >30%. The patient was referred for outpatient toxicologic evaluation. Additional genetic testing confirmed normal NAPDH methemoglobin reductase levels. Initial evaluation of the patient's home water supply by the municipal water supplier did not identify any pollutants outside of normal standards. The patient obtained a home water testing kit and found significantly elevated levels of nitrates and nitrites in water obtained from the kitchen sink (238 mg/L, EPA limit 10 mg/L). The patient was advised to drink only bottled water, and symptoms resolved completely.

Discussion: Adult-onset methemoglobinemia is highly suggestive of an environmental source. In this case, a comprehensive toxicologic history was performed, yet the patient continued to experience recurrent episodes requiring hospitalization and treatment. According to the municipal water supplier, the difference in values obtained by the private laboratory may be explained by a leak during the active operation of the home's dishwasher. This was supported by variance in the conductivity obtained from multiple sources in the patient's home water system.

Conclusions: In patients with a history suggestive of acquired methemoglobinemia, home water sources should be tested at multiple sites and at multiple points in time to avoid false negative results. Patients may consider commercially-available home water testing kits if resources for appropriate screening are not easily available.

KEYWORDS Methemoglobinemia; nitrite; respiratory

LeanneCook@mednet.ucla.edu

252. Utilization of telehealth by medical toxicologists

Evan Schwarz[a], Kim Aldy[b], Sharon Campleman[b], Shao Li[b], Alison Meyn[b], Stephanie Abston[b], Paul Wax[c] and Jeffrey Brent[d]; On behalf of the Toxicology Investigators Consortium (ToxIC)

[a]Washington University in St. Louis, St. Louis, MO, USA; [b]American College of Medical Toxicology (ACMT), Phoenix, AZ, USA; [c]University of Texas Southwestern, Paradise Valley, AZ, USA; [d]University of Colorado, School of Medicine, Denver, CO, USA

Background: The role of telehealth expanded during the initial phases of the COVID pandemic. A prior abstract demonstrated that toxicologist's use of telehealth during this time was fairly limited including in total number of consultations performed and billing. This follow up aims to explore how toxicologists use of telehealth evolved over the last 1.5 years as the pandemic changed and telehealth use became more normalized by the medical community.

Methods: The ToxIC Core Registry is a database of patients evaluated at the bedside by medical toxicologists. ToxIC includes cases from 38 sites across the US and 4 sites internationally. A new set of telehealth questions were added to the registry on April 1, 2020. We searched the ToxIC registry from April 2020 to March 2022 to determine how medical toxicologists were using telehealth. Only cases receiving a telehealth evaluation were included. Data collected included: description of telehealth encounter (video/internet, phone, chart review); the reason telehealth was used; and if the consultation was billed. Data from the registry was downloaded from the REDCap ToxIC Core Registry database and analyzed using simple, descriptive statistics.

Results: Toxicologists performed 278 telehealth consults from April 2020 to March 2022. There were 144 performed in 2020, 123 in 2021, and 11 through March of 2022. The average patient age was 38 with 51% ($n = 141$) being male. Most referrals came from the emergency department ($n = 139$; 50%) or the admitting service ($n = 95$; 34%). While consults occurred in the clinic, emergency department, and wards, none occurred in the intensive care unit. Similar number of evaluations were done in 2020 and 2021 over the phone (16 and 14 respectively) and via video (54 and 55 respectively) while fewer chart reviews were done (73 and 52 respectively). In 2020 and 2021, concern for the patient being infectious was a common reason for the evaluation to be performed via telehealth. Ten consults were performed via telehealth because the toxicologist did not have admitting or bedside privileges. In 2020, 74 consults were billed while 94 were billed in 2021 and 6 in 2022. Most patients were evaluated following an intentional exposure to a medication or drug. Few addiction medicine evaluations were completed via telehealth, seven in 2020 and 14 in 2021. However, four consults were done for opioid and ethanol withdrawal in 2020 while 17 were completed in 2021.

Conclusions: Telehealth appears to be infrequently used by medical toxicologists with fewer telehealth evaluations occurring in 2021 than in 2020. More consults were billed in 2021 than were billed in 2020. Toxicologists could increase the number of addiction medicine evaluations performed via telehealth as a means to increase patient and billing volume.

KEYWORDS Telehealth; toxicologists; ToxIC

schwarziee@me.com

253. Diphenhydramine and ethylene glycol coingestion results in delayed ethylene glycol absorption and post-dialysis rebound

Axel Adams[a], Brian Bush[b] and Steven Aks[c]

[a]University of Washington, Seattle, WA, USA; [b]Toxikon Consortium, Chicago, IL, USA; [c]Toxikon/Cook County Hospital, Chicago, IL, USA

Background: Toxic alcohols are common intoxicants. The most commonly ingested toxic alcohol is ethylene glycol, accounting for 5277 cases and 13 deaths in 2020 according to NPDS data. Ethylene glycol is rapidly absorbed from the GI tract with peak

plasma levels attained in 30 min to 4 h. The half-life of ethylene glycol when fomepizole is used to block alcohol dehydrogenase is 17–19 h, and the highest reported level of ethylene glycol in the literature is 888.0mg/dL. Delayed absorption and post-dialysis rebound has been observed in cases of methanol intoxication, but not with ethylene glycol.
Case report: A 19 year-old male, with a history of depression and prior suicide attempt via antifreeze overdose, presented to a small rural emergency department after being found down in a park with an empty bottle of Blue Mountain Antifreeze. On arrival, the patient was somnolent but was protecting his airway. He admitted to also ingesting 100 tabs of diphenhydramine. Presentation labs are notable for anion gap of 18 and a lab reported serum osmolality of 294 mOsm/kg; the presentation hospital was unable to perform a toxic alcohols assay. The patient was administered folic acid, pyridoxine, and 15 mg/kg fomepizole and transferred to a receiving hospital with hemodialysis capabilities. The patient's initial ethylene glycol level after being transferred was 537.3 mg/dL and the lab reported serum osmolality was 420mOsm/kg. By the time of arrival, the patient had developed a metabolic acidosis with a pH of 7.26 and bicarbonate of 14. The patient was hemodialyzed and the initial post-hemodialysis level was 151.1 mg/dL 3 h later with resolution of acidosis (pH of 7.53 and bicarbonate of 34.3). Four hours later, however, the patients ethylene glycol level increased to 182.6 mg/dL (approximately 24 h after the patient arrived at the emergency department). Patient was dialyzed a second time with an undetectable post-dialysis ethylene glycol level (288 mOsm/kg) and fomepizole was discontinued. During this time, the patient did not develop kidney insufficiency. His mental status returned to baseline, and he was transferred to inpatient psychiatry for further evaluation and management.
Discussion: To our knowledge, this is the first case demonstrating delayed absorption of ethylene glycol in the setting of diphenhydramine co-ingestion. Numerous common medications including antihistamines can cause delayed gastric emptying – especially in overdose. We hypothesize that in this case, the diphenhydramine resulted in delayed gastric emptying creating an effective gastric ethylene glycol reservoir that resulted in the delayed elevation in ethylene glycol levels.
Conclusions: This case demonstrates a severe ethylene glycol intoxication with a favorable recovery utilizing fomepizole and hemodialysis. Coingestants that cause delayed gastric emptying can result in delayed absorption and post-dialysis rebound in cases of severe ethylene glycol intoxication. Serial toxic alcohol levels can be helpful in polysubstance overdoses involving toxic alcohols despite their rapid absorption.

KEYWORDS Ethylene glycol; diphenhydramine; pharmacokinetics

axeadams@uw.edu

254. Acute thiamine deficiency as a complication of insulin euglycemic therapy for an amlodipine overdose

Emily Austin[a] and Christina Maratta[b]

[a]Ontario Poison Centre, Toronto, Canada; [b]Department of Critical Care Medicine, The Hospital for Sick Children, Toronto, Canada

Background: High-dose insulin euglycemic therapy (HIET) is a mainstay of treatment for hemodynamically unstable calcium channel blocker (CCB) poisoned patients. Predictably, common adverse events associated with HIET are hypoglycemia and hypokalemia. We present a case of a patient with severe amlodipine toxicity who developed acute thiamine deficiency with severe lactic acidosis after receiving prolonged HIET.
Case report: A 15-year old female who weighed 54 kg presented to the emergency department after an intentional overdose amlodipine, candesartan, hydrochlorothiazide, mirtazapine, fluoxetine, lorazepam and lansoprazole. She was previously healthy and was on the 50th centile for weight-for-age. Shortly after presentation, she became hypotensive and required insulin, norepinephrine, epinephrine and vasopressin infusions for hemodynamic support. She also developed acute respiratory distress syndrome (ARDS) and required inhaled nitric oxide and prone positioning for severe hypoxemia. Her initial lactate was 4 mmol/L. Her respiratory status rapidly improved and was extubated on admission day 2, however she continued to require norepinephrine (0.02–0.2 mcg/kg/min) and insulin (1–2 units/kg/h) with supplemental dextrose (100 mL/h D50%; GIR 16 mg/kg/min) to maintain a normal mean arterial pressure, many days after initial presentation. Her heart rate was 140 bpm and serum lactate ranged from 2 to 8 mmol/L. She refused oral intake, despite encouragement. Persistent amlodipine toxicity was felt to be unlikely but could not be entirely excluded. On day 11, serum lactate peaked at 11.4 mmol/L. An echocardiogram demonstrated hyperdynamic cardiac activity. Insulin and dextrose infusions were discontinued because persistent amlodipine toxicity was unlikely. On day 12 of admission, acute thiamine deficiency was considered in the absence of other causes of persistent lactatemia. The patient received an initial dose of 100 mg IV with a decrease in her serum lactate from 11.4 to 7.7 mmol/L. Thiamine replacement (250 mg IV TID) was administered for 5 days. Her serum lactate normalized after 2 days of treatment. On day 14, the patient was transferred to the ward and on day 16, she was discharged from hospital.
Discussion: We present a case of a pediatric patient with severe amlodipine toxicity who developed acute thiamine deficiency after receiving HIET for 11 days. While HIET is associated with improved cardiac output in CCB poisoned patients, prolonged administration in our patient may have predisposed her to developing acute thiamine deficiency. Thiamine is an essential co-factor for the metabolism of pyruvate to acetyl-CoA. A deficiency in thiamine results in an inability for pyruvate to enter the Cori cycle, and pyruvate is instead metabolized to lactate. Critically ill-patients receiving high-carbohydrate diets are considered high risk for acute thiamine deficiency. Our patient received HIET for 11 days, required dextrose supplementation and had limited oral intake. She developed hyperdynamic cardiac function and hyperlactatemia, which resolved rapidly after administration of IV thiamine. The prolonged administration of HIET possibly led to depletion of thiamine stores in the presence of fasting.
Conclusions: We report a novel adverse event after prolonged HIET for an amlodipine overdose. This case highlights a potential treatment side effect and the importance of continuously reassessing the need for HIET when treating CCB intoxication.

KEYWORDS High-dose insulin euglycemia; calcium channel blocker overdose; lactic acidosis

eaustin0@gmail.com

255. Epiglottitis following exposure to brodifacoum-contaminated synthetic cannabinoids

William Doyle Jr[a] and Justin Arnold[b]

[a]University of South Florida, Tampa, FL, USA; [b]Florida Poison Information Center Tampa, Tampa, FL, USA

Background: Epiglottitis typically presents as the result of an infection. However, we present a case of epiglottitis as a result of a brodifacoum exposure following synthetic cannabinoid use.
Case report: A 33-year-old woman presented to the emergency department with abdominal pain and gingival and vaginal bleeding. The patient had an elevated INR >8.5, a low hemoglobin of 11.0 g/dL, and low hematocrit of 35.1%. She was immediately treated with 10 mg of Vitamin K1 orally. She admitted to using

synthetic cannabinoids and contamination with brodifacoum was suspected. After admission she developed ecchymosis on her hands and blisters on her tongue. Qualitative testing was positive for brodifacoum. The patient was discharged with an improved INR of 1.4 seven days later on a total daily dose of 50 mg oral vitamin K TID. Fourteen days after discharge, she represented with widespread ecchymosis, leg swelling, and intermittent gingival and vaginal bleeding. Her INR was >8.5. She was again controlled via 50 mg TID oral Vitamin K therapy, stabilized, and discharged 3 days later. Twenty-eight days following the second discharge the patient represented with oral swelling, right eye ecchymosis, and vaginal bleeding after abstaining from Vitamin K therapy for 2 weeks. Her labs showed an INR >8.5 and she received four factor prothrombin complex concentrates and otolaryngology consultation due to the epiglottic edema. A bedside nasopharyngolaryngoscopy showed the base of the tongue, epiglottis, AE folds, arytenoids, and false vocal folds all edematous with ecchymosis. A CT soft tissue neck with contrast demonstrated diffuse enlargement of the epiglottis, arytenoids, and lingual tonsils with a narrowing of the airway at the level of the hypopharynx. Due to the diffuse edema and ecchymosis around the lingular tonsils, base of the tongue, and supraglottic region, the patient underwent flexible fiberoptic orotracheal airway intubation to avoid further decompensation. The patient received IV and oral Vitamin K1 and was extubated 2 days later with an INR of 7.2. She was also given empiric antibiotics to cover infectious etiologies, despite absence of fever, leukocytosis, or other infectious features. Her INR fully normalized, and she was then discharged on day four.

Discussion: Epiglottis is most often infectious in nature, but other causes can include thermal exposure to cannabis or crack cocaine, trauma or hematomas associated with hemophilia, and some systemic conditions. Our case could demonstrate thermal injury associated with smoking synthetic cannabinoids, but given diffuse ecchymosis and severe coagulopathy, hematoma associated with brodifacoum poisoning was felt to be the most likely etiology. The patient's coagulopathy was rapidly reversed, empiric antibiotic coverage was provided, and she rapidly improved.

Conclusions: Brodifacoum exposure has been known to cause increased bleeding, as seen with this case. However, now it should also be considered that brodifacoum exposure can lead to supraglottitis. If a similar patient is presented in the future, it is important to consider the coagulopathy may be caused by the adulteration of drugs of abuse, specifically, brodifacoum with synthetic cannabinoids.

KEYWORDS Epiglottitis; brodifacoum; coagulopathy

doylew@usf.edu

256. Use of endoscopic gastric decontamination and fomepizole in the treatment of massive extended-release acetaminophen overdose complicated by bezoar and persistently elevated APAP level

Manpreet Bassi[a], Christopher Sweat[a] and Patil Armenian[b]

[a]UCSF Fresno Toxicology, Fresno, CA, USA; [b]UCSF Fresno, Fresno, CA, USA

Background: Acetaminophen (APAP) is one of the most widely used medications in the western world, with its availability and low therapeutic index resulting in liver injury leading to thousands of hospitalizations and hundreds of deaths annually. We present a case of massive extended-release APAP overdose which required multiple adjunct therapies due to continued absorption and bezoar formation.

Case report: A 23-year-old 75 kg male presented to the emergency department 1–3 h after ingesting potentially 188.5 g of extended-release acetaminophen (APAP) and unknown amounts of naproxen, ibuprofen, hydrocodone and loratadine. On arrival, he was extremely agitated requiring sedation with 300 mg IM ketamine, but was then intubated due to laryngospasm. Initial labs notable for [APAP] 228 mcg/mL, bicarbonate 14 mmol/L and lactate 11.3 mmol/L. He was started on IV N-acetylcysteine (NAC) using institutional 2 bag regimen (200 mg/kg over 4 h then 100 mg/kg over 16 h) and was given 50g activated charcoal (AC). Lactate cleared within 3 h. Repeat [APAP] 20 h after admission rose to 287 mcg/mL, though transaminases were normal. NAC was continued and APAP trended. While APAP level initially dropped to 215 mcg/mL by hr 29, at hr 34 increased to 278 mcg/dL and transaminases rose. Rate of NAC was doubled, he was given a loading dose of fomepizole 15 mg/kg and an additional 50g AC. [APAP] slowly declined, but plateaued at 186 mcg/dL at hour 44. Given concern for bezoar and ongoing absorption, abdominopelvic CT was obtained demonstrating layering of pills within stomach. Emergent endoscopy was requested and performed at hour 47, identifying and removing a large pill bezoar. Over the next 6 h, the patient's [APAP] dropped from 186 to 102 mcg/mL. No significant acidosis or renal injury occurred, though with rising transaminases (AST 209, ALT 298) and INR 4.2 the patient was transferred to a transplant facility as NAC and fomepizole were continued. He was started on continuous renal replacement therapy prior to transfer at request of the transplant team. He remained hospitalized for 7 days with detectable APAP level until 96 h after presentation, transaminases rising above level of detection and INR peaking at 7.6 before he recovered without hepatic transplant.

Discussion: In this unusual case involving a massive extended-release APAP ingestion, our patient developed acute hepatic failure despite prompt treatment with IV NAC and continued to have an [APAP] greater than 100 mcg/mL for over 48 h that did not clear until gastric bezoar was removed. Extended-release APAP formulations increase risk of late toxicity from bezoars, which should be considered when APAP levels don't decrease as anticipated. Although NAC is typically effective in preventing liver failure when initiated within 8 h, it is not always sufficient, prompting consideration of adjuncts such as fomepizole. Fomepizole is a potent CYP2E1 inhibitor and JNK inhibitor, with potential promise in limiting hepatotoxicity.

Conclusions: Due to APAP bezoar formation, this patient required aggressive GI decontamination, double dose N-acetylcysteine, fomepizole, and intensive supportive care, making a full recovery without transplant.

KEYWORDS Acetaminophen; APAP; transplant

Manpreet.bassi@ucsf.edu

257. Trouble in paradise: 2021 red hill drinking water contamination event – regional poison center and state health department collaboration

Shireen Banerji[a], Diana Felton[b] and Alvin Bronstein[c]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]Hawaii State Department of Health, Pearl City, HI, USA; [c]Hawaii Department of Health, Honolulu, HI, USA

Background: In November 2021, thousands of residents on the Hawaiian island of Oahu began noticing a fuel odor in their tap

water. The cause was a leak of jet propellant (JP-5), which is a military aircraft fuel, from the Navy's Red Hill underground storage tank facility that contaminated the Joint Base Pearl Harbor Hickam (JBPHH) Water System. Thousands of people sought medical care for symptoms related to the exposure and the event was front-page news for weeks. The Hawaii Poison Center (HPC) received its first calls ($n = 6$) from affected residents on November 28, 2021. The callers described a strong gasoline-like odor with some also reporting a visible oily sheen on the surface of their tap water. On November 29, 2021, HPC notified the Hawaii Department of Health (DOH) of this cluster of cases and later that day, the DOH issued a news release advising the public to not consume water from the JBPHH water system. The JBPHH water system supplies base housing, seven elementary schools, many childcare facilities and businesses and a neighborhood of 1100 civilian homes. HPC call volume related to the water contamination increased daily and the DOH was overwhelmed with calls. HPC calls continued over the following 3 months peaking with 2 days of 30 calls per day. The DOH and HPC collaborated on call management and public health messaging. HPC staff were advised on proper NPDS product selection using the contaminated water product code. All cases were reviewed to ensure correct coding and shared daily with DOH. We aim to characterize these exposures.

Methods: We queried NPDS for human exposure cases coded to contaminated water from January 1, 2021 to March 15, 2022. Case narratives were reviewed, and cases not related to the event were excluded. We used descriptive statistics to describe the calls.

Results: 164 cases were retrieved. Fourteen were excluded (information only, animal exposures, non-event exposures). 148 human exposures related to the event were identified. Calls occurred from November 28, 2021 to February 15, 2022. 80/148 patients (54%) were female with 5/148 (3%) being pregnant. The most common age range was 20–40 years old. The 5 most reported adverse effects were: headache (29%), diarrhea (21%), abdominal pain (18%), rash (17%), and nausea (15%). There were no major outcomes or deaths; 7% with moderate outcome, 81% with minor outcome, 14% with no effect, and 5% marked as unrelated. The most common route of exposure was ingestion (51%), followed by dermal (21%), inhalation (18%), and unknown (10%). Onsite (non-healthcare facility) management occurred in 47% of cases with the PC referring 34/148 (23%) for medical evaluation, and 42/148 (28%) originating from a healthcare facility.

Conclusions: Environmental contamination events can escalate quickly and health departments may not have capacity to field an influx of calls. Poison Centers can complement the state's resources and help in early identification of environmental emergencies. Capturing these calls is invaluable to state and local public health agencies and CDC. Cohesive efforts between DOH and HPC during the Red Hill water contamination event resulted in early identification of the scope of the environmental contamination and consistent messaging for concerned Oahu residents and healthcare providers. Collaboration between health departments and regional poison centers is vital to an effective response when public health events intersect with toxicological etiologies.

KEYWORDS Public health; environmental contamination; health department

shireen.banerji@rmpds.org

258. Olanzapine overdose presenting as an acute stroke mimic successfully treated with physostigmine

Brian Wiener[a], Susi Vassallo[a] and Mark Su[b]

[a]Division of Medical Toxicology, Ronald O Perelman, Department of Emergency Medicine, NYU Grossman SOM, New York, NY, USA; [b]Department of Health and Mental Hygiene, New York City Poison Control Center, New York, NY, USA

Background: Olanzapine is an atypical antipsychotic prescribed for Major Depressive Disorder (MDD), schizophrenia, and bipolar disorder. Olanzapine overdose can cause central antimuscarinic delirium; there are multiple case reports of olanzapine induced antimuscarinic toxicity treated successfully with physostigmine. However, focal neurologic deficits are not characteristic of olanzapine toxicity. We present a patient with an acute surreptitious overdose of olanzapine triaged as a "stroke code" because of altered mental status and focal neurologic deficits that resolved upon administration of physostigmine.

Case report: A 58-year-old man with a history of MDD with psychotic features presented to the emergency department with acute confusion and delirium. His initial vital signs were: BP, 118/67 mm Hg; HR, 127 beats/minute; RR, 10 breaths/minute; T, 97.80 F orally; O2 saturation 91% (RA); Point of care glucose, 104 mg/dL. The oxygen saturation improved to 100% with the administration of 2 L/min of oxygen via nasal cannula. The patient's physical examination was notable for minimal response to painful stimuli and a left-sided facial droop. The eyes were deviated upwards. The pupils were dilated to 5 mm, the skin and mucous membranes were dry, bowel sounds were decreased, and the bladder was distended. An electrocardiogram demonstrated sinus tachycardia at a rate of 123 beats/minute; a QRS complex duration of 80 milliseconds, and no terminal R wave in lead aVR. Advanced imaging was normal, including a non-contrast computerized tomography (CT) of the brain, CT angiography of the brain and neck, and CT perfusion scan. After these diagnostic studies were performed, a nurse found an empty bottle of olanzapine 7.5 mg tablets in a pocket of the patient's clothing. Physostigmine, 1 mg, was slowly infused intravenously (IV) over 5 min. Within minutes after administration, the patient's mental status improved from obtundation and unresponsiveness to being awake with a clear sensorium. His neurologic deficits also resolved completely. The patient was then able to make appropriate eye contact, speak in full sentences, and provide a history of overdosing on olanzapine. Two hours later, the patient became obtunded a second time and was slowly given additional IV physostigmine, 1 mg, with return of normal mentation. After the second dose of physostigmine, the patient's mental status remained normal throughout the rest of his hospital course. A blood olanzapine concentration obtained 8 h after the patient presented to the ED was elevated at 162 ng/mL (reference range 10–80 ng/mL) thus supporting the diagnosis of an olanzapine overdose.

Conclusions: Olanzapine overdose typically presents with altered mental status and antimuscarinic toxicity. Our case describes a patient with an olanzapine overdose who presented with antimuscarinic toxicity but also with focal neurologic deficits mimicking an acute stroke. Physostigmine reversed the olanzapine-induced antimuscarinic signs and the focal neurological deficits completely. Providers should be aware of possible focal neurologic deficits occurring in the setting of olanzapine toxicity and the utility of physostigmine as a reversal agent.

KEYWORDS Olanzapine overdose; physostigmine; stroke/CVA

bwiener2@gmail.com

259. Treatment of pediatric antimuscarinic delirium with oral rivastigmine

Brandtly Yakey[a], Varun Vohra[a], Amarilis Martin[b] and Andrew King[a]

[a]Michigan Poison and Drug Information Center, Detroit, MI, USA; [b]Pediatric Critical Care Medicine, Children's Hospital of Michigan, Detroit, MI, USA

Background: Antimuscarinic drug overdose is a common pediatric emergency. Antimuscarinic agents antagonize muscarinic acetylcholine receptors, producing a toxidrome with both central and peripheral symptoms. In addition to supportive care, treatment of agitation and hyperactive antimuscarinic delirium is critical to prevent serious sequelae. Intravenous (IV) physostigmine salicylate is a reversible cholinesterase inhibitor used as an antidote to treat central antimuscarinic delirium due to its ability to readily cross the blood-brain barrier. A nationwide physostigmine shortage has prioritized the consideration of therapeutic alternatives. Rivastigmine is a long-acting cholinesterase inhibitor with a similar structure to physostigmine and a potentially viable therapeutic option for antimuscarinic delirium.
Case report: A 7-year-old male presented to the emergency department (ED) for a suspected food-related allergic reaction. Approximately 2 h prior to presentation, his mother administered a "standard dose" of an over-the-counter liquid formulation of dextromethorphan and doxylamine for his sore throat. The patient's history was significant for self-administering medicine without parental supervision. Shortly after arrival to the ED, the patient developed two generalized tonic-clonic seizures that were treated with IV lorazepam and levetiracetam. In addition, he received IV diphenhydramine for a suspected allergic reaction. He developed worsening agitation, tachycardia, incoherent speech, and hallucinations. A comprehensive gas chromatography/mass spectrometry analysis of the patient's urine was positive for diphenhydramine and doxylamine. He was admitted to the pediatric intensive care unit where he required multiple doses of benzodiazepines for agitation. The toxicology service was consulted and a bedside evaluation was consistent with antimuscarinic delirium. Due to the national shortage of physostigmine, rivastigmine was recommended. One dose of oral rivastigmine 0.75 mg was administered approximately 24 h post-initial presentation. The patient's delirium significantly improved over the next 6 h precluding the need for further benzodiazepines.
Discussion: This, to our knowledge, is the first pediatric case report highlighting the treatment of central antimuscarinic delirium with rivastigmine. Physostigmine remains the preferred agent to reverse central antimuscarinic delirium. However, due to its supply shortage, other therapeutic options should be investigated. Few case reports describe the successful use of rivastigmine to treat delirium secondary to antimuscarinic xenobiotics. Pharmacologically, rivastigmine offers potential benefits over physostigmine including a longer duration of action, slower rate of central nervous system penetration, less severe side effects, and availability in multiple formulations.
Conclusions: Rivastigmine is a potential alternative treatment for antimuscarinic delirium warranting further investigation in light of the national physostigmine shortage. This case report adds to the current literature outlining its use in the pediatric setting. Prospective trials are warranted to appraise rivastigmine's utility and safety as a reversal agent for antimuscarinic delirium.

KEYWORDS Pediatric; antimuscarinic; rivastigmine

ci7465@wayne.edu

260. Veratrum toxicity: a rare etiology of the hypotensive/bradycardic patient

LilyAnne Jewett, Stacy Marshall and Jonathan Ford

UC Davis Health, Sacramento, CA, USA

Background: *Veratrum*, also known as false hellebore, is a genus of flowering plants that grow across much of Europe, Asia, and North America. Most *Veratrum spp.* contain cardiotoxic alkaloids that are present in all parts of the plant but are most concentrated in the roots and rhizomes. *Veratrum* alkaloids are sodium channel openers with a mechanism similar to aconite, classically presenting initially with nausea, vomiting and abdominal pain, followed by bradycardia, hypotension, apnea, and dysrhythmias. Presently, toxicity from ingestion of *Veratrum spp.* is rare.
Case report: An elderly couple (70-year-old female and 76-year-old male) presented to the ED with intractable vomiting and abdominal pain that started approximately 2 h after ingesting a foraged plant thought to be wild asparagus. Both patients were hypotensive and bradycardic on arrival to the ED, the female patient with HR 47 and BP 86/47, and the male patient with HR 48 and BP 86/50. The physical exam was otherwise unremarkable. The female patient was noted to be hyperkalemic to 6.1 mEq/L and her EKG revealed sinus bradycardia with normal intervals. The poison control center (PCC) at that time recommended administering DigiFab if the patients did not respond to supportive measures due to concern for cardiac glycoside toxicity. A digoxin level was sent. The patients were treated supportively with IV fluids and anti-nausea medication with improvement in symptoms and vital signs, the female patient with repeat HR 53 and BP 137/96, the male patient with HR 53 and BP 122/65. Both maintained normal mentation throughout resuscitation. A repeat potassium for female patient was 4.9 mEq/L. Digoxin levels returned undetectable for both patients. The couple's son later presented to the ED with samples and photographs of the foraged plant which was identified by the treating physician as *Veratrum californicum*. Both patients were observed in the hospital for approximately 72 h with complete resolution of symptoms and normalization of vital signs prior to discharge home.
Discussion: Our patients experienced significant GI symptoms and mild cardiotoxicity after ingestion of a foraged plant later identified as *V. californicum*. *Veratrum* leaves are often mistaken for wild garlic or wild leeks/ramps, however our patients misidentified the *Veratrum* stalk as wild asparagus. Although *Veratrum* alkaloids have some similarities to cardioactive glycosides, they instead bind to voltage-gated $Na+$ channels. They specifically target the voltage-gated channels within the vagus nerve resulting in the classic triad of hypotension, bradycardia, and apnea. While there have been case reports of *Veratrum* alkaloids cross-reacting with the digoxin assay, it has also been shown in vitro to not be bound by Digifab. Treatment for a known *Veratrum spp.* ingestion includes atropine for bradycardia and cardiovascular support with IV fluids and vasopressors as needed.
Conclusions: While infrequently consumed, providers should be aware that *Veratrum* species are ubiquitous across the US and can be misidentified as wild garlic, wild leek, and wild asparagus. *Veratrum* toxicity should be considered in a patient with GI symptoms, hypotension, and bradycardia, especially in the setting of exposure to foraged plants.

KEYWORDS Veratrum; foraging; cardiotoxicity

ljewett@ucdavis.edu

261. A Poison center assessment of high dose insulin/euglycemia therapy (HDIET) versus other non-HDIET cardiovascular support in beta-blocker and calcium channel blocker toxicity

Curtis Elko, Paul Cole and Trent Eason
Washington Poison Center, Seattle, WA, USA

Background: Beta-blocker (BB) and calcium channel blocker (CCB) overdoses are currently managed with high-dose insulin/euglycemia therapy (HDIET) and non-HDIET (vasopressors, calcium, atropine, glucagon, intralipid emulsion therapy (ILET) and extracorporeal membrane oxygenation-ECMO). This study evaluates management duration and perceived benefits of HDIET versus non-HDIET therapies for BB/CCB toxicity.
Methods: This single retrospective poison center study of BB/CCB hospital-managed cases was performed by 3 reviewers, with differences resolved by consensus. ToxiCALL(R) codes for substance(s), therapies, clinical effects and severity outcomes for 2019–2020 (HDIET) and 2010–2013 (non-HDIET) were exported to EXCEL(R). Included non-HDIET cases used vasopressors or >1 other non-HDIET modality. Cases were excluded if deemed unrelated to BB/CCB or having poor documentation. Treatment durations, minimum heart rates (HR) and systolic blood pressures (SBP) were extracted from case notes and any imprecise intervals or ranges were recorded as midpoint values. Maximum HDIET doses (units/kg/h) were calculated either by exact weight or by the cohort average (100 kg). Averages include standard deviation (± SD). One-tailed statistical variable comparisons were calculated using either *t*-test, chi-square or Fischer Exact test, as indicated for variable type (significance, $p < 0.05$).
Results: HDIET cases were 41 and non-HDIET cases were 105. HDIET versus non-HDIET case demographics were not statistically different ($p \geq 0.05$) for the following parameters: mean age (years) (53 ± 16 vs 52 ± 18); male:female ratio (0.64 vs 0.67); suicidal intent (88% vs 72%); substance-type BB-only (29% vs 28%), CCB-only (56% vs 52%) or BB + CCB (15% vs 20%); non-HDIET type including vasopressors (83% vs 80%) glucagon (68% vs 66%), atropine (22% vs 21%), ECMO (2% vs 0%) and calcium (63% vs 62%); severity outcome including Moderate (56% vs 59%), Major (34% vs 37%) or Death (10% vs 3.8%); and lastly, average minimum SBP mmHg (82 ± 20 vs 81 ± 20). In contrast, significant differences for HDIET vs non-HDIET cases were found for the following: average minimum HR (62 ± 26 vs 55 ± 18, $p < 0.05$) and ILET use (32% vs 8.6%, $p = 0.001$). Case management duration (hours) were tested for statistical difference (*t*-test for unequal variance) for HDIET vs non-HDIET groups. Total case durations were not statistically different (186 ± 434 vs 71 ± 53; $p = 0.05$) but non-HDIET usage duration differed (47 ± 49 vs 23 ± 22; $p < 0.002$). HDIET usage duration was 31 ± 29 h and average insulin dose was 2.1 ± 2.7 units/kg/h. The reviewers found HDIET case efficacy was "definite" in 58%, "possible" in 32% and "ineffective" in 10%. A reviewer-assessed measure of HDIET efficacy was if non-HDIET support could subsequently be weaned and this was noted in 24 cases (59%). However, HDIET was stopped in 17 cases (42%) due to adverse events (hypoglycemia, electrolyte loss, volume overload) or ineffectiveness.
Conclusions: While the HDIET and non-HDIET BB/CCB cases showed similar case characteristics, HDIET cases had longer duration of cardiovascular support. The longer management duration for HDIET cases was likely due to greater case severity rather than lack of efficacy as reviewers noted that HDIET was either definitely or possibly effective in 90% of cases. Both HDIET and non-HDIET therapy were central to case management and HDIET seemed suitable for more severe or refractory cases.

KEYWORDS Beta-blocker; calcium-channel-blocker; insulin/euglycemia

elko@wapc.org

262. Improvement in mental status after high dose naloxone in the setting of tizanidine poisoning: a case report

Greta Kreider Carlson[a], Rebecca Lange[b] and Jon Cole[b]
[a]Hennepin Healthcare, Minneapolis, MN, USA; [b]Minnesota Poison Control System, Minneapolis, MN, USA

Background: Tizanidine is a central alpha-2 agonist (CA2A) predominantly used to treat muscle spasticity. In overdose, physiological effects can include lethargy, CNS depression, bradycardia, and hypotension. High dose naloxone, up to 10 mg, has been purported to reverse encephalopathy from other CA2As (primarily clonidine), however, evidence in tizanidine poisoning is limited to two case reports. We present a case of tizanidine overdose with improvement in mental status following high-dose naloxone administration.
Case report: A 57-year-old woman with prior history of stroke, hypertension, and chronic back pain presented to the Emergency Department (ED) with profound sudden onset encephalopathy 1 h prior to arrival. Pre-hospital, EMS reported systolic blood pressures in the 60 mmHg range and bradycardia, and administered 2 mg IV naloxone without significant effect. She intermittently answered questions with 1–2 word answers and slurred speech. She was unable to provide significant history other than reporting taking extra tizanidine. EKG showed normal sinus rhythm with QTc =522 ms. Blood pressure nadir was 75/65, 6 min after arrival, and she remained inappropriately bradycardic (HR 73–86) throughout her ED course. Pupils were small and minimally reactive. CT stroke series demonstrated no acute finding. She was given 10 mg IV naloxone (0.12 mg/kg) from a single syringe as a rapid bolus. Within one minute, she had modest improvement in hemodynamics, with systolic blood pressure in the 80–90s. The most significant change was in mental status: she was able to answer questions, and for the first time demonstrated orientation to person, place, and time. She confirmed taking extra tizanidine due to chronic pain. After 10–15 min, the patient became drowsy again but did not require more naloxone. She was admitted to a floor bed and cleared overnight. The patient later reported taking extra tizanidine, as well as usual doses of cyclobenzaprine, hydroxyzine, and diazepam. Liquid and gas chromatography with mass spectrometry was negative for opioids, (including oxycodone, buprenorphine, methadone, opiates, and fentanyl), but did not have a standard for tizanidine.
Discussion: This case represents an example of partial reversal of tizanidine toxicity with high dose naloxone. The mechanism of reversal is likely similar to clonidine, whereby naloxone reverses the effects of excess ß-endorphin released in response to excessive clonidine (or tizanidine). While other case reports have demonstrated more complete reversal of encephalopathy following administration, we suspect co-ingestion of other centrally acting medications contributed to incomplete reversal in our case. While occult opioid poisoning could always theoretically be present (and provide an alternative explanation for this patient's response), this patient underwent extremely thorough drug screening which did not detect any opioids, nor did she endorse using opioids. In this case, the partial response allowed for rapid

clarification of the history of present illness confirming tizanidine overdose, rapidly narrowing our differential diagnosis.
Conclusions: We present a case of acute toxic encephalopathy related to tizanidine ingestion, markedly improved with high-dose naloxone. This case adds support for a trial of high-dose naloxone in tizanidine-poisoned patients with encephalopathy, provided there is no clinical contraindication to naloxone.

KEYWORDS Tizanidine toxicity; high-dose naloxone; acute toxic encephalopathy

margaret.kreidercarlson@hcmed.org

263. Mexican Hawthorn root ("Raiz de Tejocote") taken as a dietary supplement for weight loss resulting in detectable serum digoxin concentration

Rebecca Lange[a], Ryan Fuchs[b], Erin Batdorff[c], Travis Olives[d] and Jon Cole[a]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]Hennepin County Medical Center, Minneapolis, MN, USA; [c]University Of Minnesota, Minneapolis, MN, USA; [d]Hennepin Healthcare/Minnesota Poison Control System, Minneapolis, MN, USA

Background: *Crataegus mexicana*, Mexican Hawthorn root, is sold in root or capsule form under the common name of Raiz de Tejocote. It is marketed as a weight loss supplement which can be easily purchased online. The presumed mechanism to cause weight loss is high pectin content which has been associated with early satiety. The plant is also thought to contain flavonoids that antagonize Na^+/K^+ adenosine triphosphatase via a similar mechanism to cardioactive steroids and may mimic digoxin toxicity in excess quantities. The toxic dose is not well established in the literature. The presence of Raiz de Tejocote on social media promoting its weight loss benefits makes this a potential public health concern. We present a case of a teenager who took more than the directed amount in an attempt to lose weight resulting in gastrointestinal symptoms, ECG changes consistent with cardioactive steroid exposure, and a detectable digoxin concentration.
Case report: A 14-year-old girl weighing 103.7 kg presented to the emergency department approximately 18 h after ingesting at least 5 pieces of a dietary supplement purchased online called Alipotec, Raiz de Tejocote that was labeled to contain tejocote root 49 mg and pectin 21 mg. She was taking this product for weight loss after learning about it on TikTok and the product was circulating around her school. Her initial complaint was persistent vomiting. She was awake and alert with presenting vitals of pulse 92, blood pressure 120/72, respiratory rate 16 and pulse oximetry 99% on room air. Her initial ECG had a PR interval of 218 ms with 1st degree AV block, pulse 79 and normal sinus rhythm. Lab work revealed potassium of 4.6 mEq/L and a digoxin level of 0.8 ng/mL. She was not on digoxin. She was observed overnight in the pediatric intensive care unit. Repeat ECG the following morning showed 1st degree AV block with PR interval of 220 ms. A repeat digoxin level was 0.7 ng/mL. She did not require any interventions and was safely discharged home on hospital day 3 after ECG showed a shortened PR interval.
Discussion: The lack of published data on tejocote root makes clinical management challenging, including determining length of observation. In this case, it is possible cross-reactivity of the flavonoids in the tejocote plant with the polyclonal digoxin assay provided a tool to confirm ingestion of the plant. Alternatively, it is possible another cardioactive steroid was substituted for *C. mexicana*, but still sold surreptitiously as "Mexican Hawthorn root." Similar substitutions in the past have occurred with other cardioactive steroids purported to aid in weight loss, such as yellow oleander (*Cascabella thevetia*), that have been covertly sold as Candlenuts (*Aleurites moluccana*) resulting in significant toxicity and even death. As with all plants containing cardioactive steroids, treatment with digitalis antibodies is guided clinically and not by likely inaccurate serum concentrations of digoxin; rather a detectable serum digoxin concentration serves merely as a marker of exposure to an unnamed cardioactive steroid. The lack of regulation and third-party testing of these supplements also makes potency and potential for contaminants a significant concern.
Conclusions: Mexican Hawthorn root (*C. mexicana*), when taken as a dietary supplement for weight loss, may result in digoxin-like cardiac effects and a detectable serum digoxin concentration.

KEYWORDS Dietary supplement; weight loss; cardioactive steroids

rebecca.lange@hcmed.org

264. Trends of case complexity at a regional poison center

Joseph Lambson and Amberly Johnson

University of Utah/Utah Poison Control Center, Salt Lake City, UT, USA

Background: Poison center staffing requirements have historically been based on case volume. Though case volume has declined over the last decade, cases have become increasingly more complex requiring a higher level of management. This descriptive study aims to characterize trends in the complexity of cases reported to one regional poison center over the last two decades.
Methods: We conducted a retrospective descriptive study of calls originating to one regional poison center between January 1, 2000, to December 31, 2019, using Toxicall®. Data includes the annual frequency of common NPDS codes. Animal and webPOISONCONTROL® data were excluded. Descriptive statistics were conducted with Excel®. All percent changes were calculated as averages of 10-year spans.
Results: Between 2000 and 2009, the total number of cases increased by 18.3%. Human exposures increased by 27.0% and information calls decreased by 21.5%. Exposures in children <13 years and adults increased by 28.1% and 33.2%, respectively. Exposures in adolescents 13–19 years decreased by 4.1%. Unintentional exposures increased by 25.9%. Intentional exposures increased by 33.3% with a 29.9% increase in suicide. Exposures involving pharmaceutical agents increased by 48.9% compared to 16.6% in nonpharmaceutical agents. Exposures with >4 clinical effects versus ≤ 4 saw the greatest increase. Calls originating from own/other residence and a health care facility increased by 22.9% and 65.5%, respectively. Exposures managed at home increased by 25.0%. Exposures managed at a health care facility increased by 76.0% with the greatest increase in non-critical (230.7%) and critical units (173.7%). Exposures with moderate, severe, and death outcomes increased the most. Between 2010 and 2019, the total number of cases decreased by 15.9%. Human exposures decreased by 8.6% and informational calls by 74.2%. Exposures in children <13 years decreased by 23.1%. Exposures in adolescents 13–19 years and adults increased by 36.4% and 10.1%, respectively. Exposures with unintentional intent decreased by 15.9%; however unintentional therapeutic errors and environmental increased by 20.7% and 61.6%, respectively. Exposures with intentional intent increased by 30.0% with the greatest increase in suicide at 57.8%. Exposures involving pharmaceutical agents increased by 0.7%. Nonpharmaceutical agents decreased by 10.1%. Exposures with

≤4 clinical effects decreased and nearly all exposures with >4 clinical effects increased. Calls originating from own/other residence decreased by 19.0%. Calls originating from health care facilities increased by 43.0%. Exposures managed at home decreased by 13.8%. Exposures managed at a health care facility increased by 10.4% with the greatest increase in non-critical and critical units at 40.1% and 41.0%, respectively. Exposures with no effect decreased by 5.1% whereas exposures with moderate and major outcomes increased the most.
Conclusions: While total case volume has decreased in the past decade at our regional center, case complexity has continued to increase. Exposures are more intentional, more frequently involve pharmaceutical agents, more commonly originate from a health care facility, and are experiencing more severe outcomes. Further research should be conducted to determine these trends' impact on poison center workload.

KEYWORDS Case complexity; poison centers; case volume

joseph.lambson@pharm.utah.edu

265. Olanzapine poisoning in Taiwan: a poison center-based study

Ming Shiah[a], Yang Chen-Chang[b] and Chen Hsiang-Ling[b]

[a]Department of Pharmacy, National Yang-Ming University School of Medicine, New Taipei City, Taiwan; [b]National Poison Control Center and Division of Clinical Toxicology and Occupational Medicine, Taipei, Taiwan

Background: This study aimed to summarize the demographic and clinical characteristics of olanzapine poisoning cases reported to the Taiwan Poison Control Center (PCC-Taiwan) and to identify clinical characteristics associated with the severity of poisoning.
Methods: This study retrospectively reviewed all olanzapine poisoning cases reported to PCC-Taiwan from 2001 to 2021. Patients were divided into 2 groups, i.e., moderate-to-severe poisoning vs asymptomatic-to-mild poisoning; Data analyses were then conducted to compare the differences in baseline characteristics between the two groups.
Results: After excluding nine patients with incomplete data, a total of 41 patients, including 18 males (43.9%) and 23 females (56.1%), were eligible for final analysis. Most patients (70.7%) were poisoned due to attempted suicide. The median age was 28 years old (ranged from 1 to 71 years), and the average ingested dose was 144 mg. Among 30 patients (73.2%) with co-ingestants, the most common co-ingestants were benzodiazepines (46.3%) and antidepressants (17%). The most commonly observed symptoms were drowsiness (53.7%), central nervous system depression (24.4%) and confusion (12.2%). In terms of severity, there were 2 severely poisoned patients (5%), 14 moderately poisoned patients (34%), 23 patients (56%) of mild toxicity, and 2 asymptomatic patients (5%). Confusion was the only statistically significant variable that was associated with the risk of having moderate-to-severe toxicity ($p < 0.01$).
Conclusions: Most patients of olanzapine poisoning reported to the PCC-Taiwan were of mild-to-moderate toxicity. Moreover, the demographic and clinical characteristics were similar between patients of different severity, with confusion being the only exception. Larger scale studies are warranted to identify other significant predictors of severity among olanzapine poisoned patients.

KEYWORDS Olanzapine; poisoning; poison control center

mark29935161@gm.ym.edu.tw

266. Ventricular tachycardia secondary to unintentional naphthalene inhalation

Vincent Calleo[a], James Mangano[a], Daniel Tirado[a] and Jeanna Marraffa[b]

[a]SUNY Upstate Medical University, Syracuse, NY, USA; [b]Upstate NY Poison Center, Upstate Medical University, Syracuse, NY, USA

Background: Mothballs are commonly used in the US and often contain high concentrations of naphthalene or paradichlorobenzene. Though exposures are frequently accidental in pediatric patients or intentional in adolescents and adults, unintentional adult exposures may occur and can result in significant toxicity. We present a unique case of ventricular tachycardia secondary to unintentional inhalation of naphthalene.
Case report: A 48-year-old male with no significant cardiac history and no substance use history presented to the Emergency Department (ED) with palpitations. Just prior to arrival, the patient had removed the canopy of his winterized boat and noted a strong odor. He had placed mothballs under the canopy prior to winterizing the boat, and was removing the canopy for the first time in months. He worked in the boat for about 10 min prior to developing palpitations and lightheadedness. He subsequently presented to the ED where he was noted to have a heart rate of 201 beats per minute and respiratory rate of 24 breaths per minute; he was otherwise hemodynamically stable. His ECG revealed ventricular tachycardia with a QRS of 208 ms and QTc of 589 ms. He was given 150 mg IV amiodarone and 2 g IV magnesium which resulted in chemical cardioversion to sinus rhythm. His LFTs revealed a mild transaminitis, with the AST/ALT peaking at 56 and 55, respectively; his CBC, BMP, magnesium, methemoglobin, and troponin levels were within normal limits. His urine drug screen was negative. Cardiac workup was unrevealing. Naphthalene serum and urine confirmatory testing was unfortunately unable to be performed as appropriate samples were not available. He was discharged 2 days after presentation and has had no recurrence of symptoms.
Discussion: This patient's exposure to highly concentrated naphthalene fumes in a relatively enclosed space was likely the source of his ventricular tachycardia as he had no prior dysrhythmias, no other known exposures, and has had no further episodes since this event. We did not encounter any previously reported cases of cardiac dysrhythmias secondary to unintentional inhalational exposures to naphthalene in the medical literature. Other aromatic hydrocarbons, such as toluene, are thought to potentially precipitate cardiac conduction abnormalities, including QT prolongation, secondary to QT dispersion. Though naphthalene is an aromatic hydrocarbon like toluene, we have found no reports of conduction abnormalities secondary to unintentional inhalation. Other typical findings for naphthalene toxicity, including hemolysis, were not present, suggesting short, acute unintentional exposure may not be enough to cause hemolysis. Although definitive laboratory testing was unable to be performed for mothball product confirmation, bedside testing of the mothballs from the boat revealed they were faintly radiopaque, sank in water, and floated in a D50 solution; these findings are consistent with naphthalene.
Conclusions: Unintentional exposure to concentrated naphthalene fumes may cause cardiac conduction abnormalities. Ventricular tachycardia secondary to unintentional naphthalene exposure was successfully managed with amiodarone and magnesium. Bedside testing of mothballs may facilitate chemical composition identification.

KEYWORDS Naphthalene; mothballs; dysrhythmias

vcalleo1@gmail.com

267. Severe gastrointestinal symptoms associated with turkesterone use

Aryn Dixon[a], Nicholas Dodson[b] and Tony Rianprakaisang[a]

[a]Department of Emergency Med, University of Kansas Med Center, Kansas City, KS, USA; [b]Department of Pharmacy, University of Kansas Med Center, Kansas City, KS, USA

Background: Turkesterone is the major ecdysteroid found in the plant *Ajuga turkestanica*. Recently, it has grown in popularity among some body builders due to proposed anabolic effects. While it is sold freely on the internet as a supplement, data on its side effects are lacking and its safety and efficacy are unclear. Here we report a single case of severe turkesterone-associated gastrointestinal symptoms leading to renal impairment and hypovolemic syncope. This is a single case report of severe gastrointestinal symptoms associated with Turkesterone use.
Case report: A 29-year-old otherwise healthy male presented to the emergency department (ED) following a syncopal episode. Two days prior to evaluation the patient reports he began taking 500mg tablets of turkesterone twice daily which he had purchased on Amazon as a workout supplement. He reported shortly after initiating the supplement, he developed abdominal cramping which progressed to significant nausea and diarrhea the day of evaluation. Throughout that day, he experienced multiple episodes of persistent, watery, non-bloody diarrhea and lightheadedness. During an episode of lightheadedness, he lost consciousness and syncopized, sustaining an occipital laceration. He denied any sick contacts or previous episodes of syncope or profuse diarrhea. He was evaluated for syncope in the ED. His vital signs on arrival were within normal limits. EKG was normal without ischemic signs or conduction disturbances. His laboratory evaluation demonstrated hemo-concentration with a hemoglobin and hematocrit of 17.6 g/dL and 51.4%, respectively. His metabolic panel demonstrated acute kidney injury with a Cr of 1.27 mg/dL but no electrolyte abnormalities. He continued to report orthostasis and nausea in the ED and was treated symptomatically with ondansetron and intravenous fluids. Subsequently, he reported improvement in symptoms and after laceration repair was discharged home in stable condition with instructions to discontinue turkesterone use. Follow-up ED visit for staple indicated resolution of gastrointestinal symptoms.
Discussion: While turkesterone is a widely available supplement used by body builders, there are little to no data on side effects or toxicity. To our knowledge this is the first case report of significant adverse events related to turkesterone use reported in the medical literature. Multiple websites endorsing turkesterone report gastrointestinal symptoms as potential side effects including nausea and diarrhea as seen in this case. In this patient, gastrointestinal symptoms were temporally related to starting turkesterone use and resolved after cessation indicating the supplement may have been causative. The patient had objective signs of hypovolemia which likely led to his syncopal event.
Conclusions: Gastrointestinal symptoms may be associated with turkesterone use and can lead to hypovolemia and syncope. Further studies and case reports are needed to document adverse events and toxicity related to this supplement. As sale and use of turkesterone supplements continues to gain popularity, toxicologists and poison control centers may encounter more cases of adverse events related to its use.

KEYWORDS Turkesterone; supplements; side-effects

adixon5@kumc.edu

268. Cracking the whip on inhalation abuse: using naltrexone as medication assisted treatment in chronic nitrous oxide use

Alek Adkins, Carin Malley, Joshua Shulman and Anthony Pizon

University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Background: Nitrous Oxide, commonly referred to as "whippets," is an addictive inhalant. Chronic daily use of nitrous oxide can cause functional vitamin B12 deficiency, which can lead to debilitating subacute combined degeneration of the spinal cord. To date, there is scarce literature regarding medication assisted treatment (MAT) to help with nitrous oxide use disorder. Naltrexone has been used to treat opioid use disorder and alcohol use disorder. One prior case report describes a reduction in daily nitrous oxide use with daily naltrexone use. The aim of this case report is to further advance the literature in showing that naltrexone may be a viable MAT option in chronic nitrous oxide inhalation use.
Case report: A 28-year-old female with a past medical history of schizophrenia, Guillain-Barre Syndrome, and nitrous oxide abuse presented to the hospital for leg weakness and balance issues. She reported a long-standing history of inhalation abuse with an increased use over the past year. For the past 2 months, she had developed a progressively unsteady gait, which she initially contributed to sitting with her legs crossed all day while consuming nitrous oxide. She reported inhaling approximately 100 canisters of nitrous oxide per day prior to arrival. Her initial exam was remarkable for muscle spasticity and diffuse weakness in bilateral legs. Initial laboratory workup was remarkable for a vitamin B12 level of 274 pg/mL, a methylmalonic acid level of $>$4000 nmol/L, and a homocysteine level of 59.8 micromoles/L. MRI of the brain and spine showed patchy areas of T2 prolongation in the lateral and dorsal thoracic spinal cord, concerning for subacute combined degeneration. The patient was started on Vitamin B12 supplementation with homocysteine and methylmalonic acid levels returning to normal limits in 32 and 23 days respectively. During her hospital stay, she endorsed severe daily cravings for nitrous oxide. She was started on 50mg oral naltrexone daily during hospital day 2 and endorsed improvement in cravings on hospital day 5 and 7. The patient was discharged to a hospital based inpatient rehabilitation program. During her rehab, she was evaluated by psychiatry and neuropsychology without documentation of worsening cravings. She was maintained on 50 mg oral naltrexone without the need for up-titration for craving control, and was discharged home after 1 month of rehab. After discharge, the patient was lost to follow up.
Discussion: Naltrexone is a competitive mu-opioid antagonist. The release of endogenous opioids in response to non-opioid addictive substances such as alcohol or nitrous oxide is a factor in the positive reward pathway. It is hypothesized that by blocking these endogenous opioids, naltrexone decreases the positive reward pathway for non-opioid substances of abuse, decreasing cravings and helping patients decrease use.
Conclusions: Chronic daily nitrous oxide use can lead to debilitating (albeit potentially reversible) neurologic sequelae with little reported treatment options other than cessation and behavioral changes. Naltrexone is potentially a viable MAT option in the multifaceted approach of maintaining nitrous oxide abstinence.

KEYWORDS Nitrous oxide; naltrexone; medication assisted treatment

adkinsaq@upmc.edu

269. A new method of etiologic treatment for cancer invented by a regional Vietnamese poison center

UyenVy Doan
Cho Ray Hospital, Ho Chi Minh City, Vietnam

Background: The etiologies of cancer are carcinogens including physical agents, biological agents, and chemical agents. There are 256 confirmed carcinogens. Cancer is a systemic generalized disease caused by one or more toxic agents. To remove the tumor by surgery is only a symptomatic treatment. Killing the cancer cells by radiotherapy or chemotherapy is also just a symptomatic treatment because radiation and chemotherapy only eliminate the cancer cells that have already formed, they do not eliminate the agent that caused the cancer. That is why the disease may recur and progress to kill the patient. As a result, many people think that cancer is an incurable disease. We have to apply both etiologic and preventive treatment before and after the symptomatic treatment. The main point in treatment of cancer should be to determine the causative agent, remove the source of exposure, and stop the abnormal proliferation process of cells in order to prevent the progression and recurrence of the disease. Source carcinogens should be determined and can assist with the diagnosis of cancer patients by medical toxicologists who can advise patients on how to prevent exposure. Individual toxic agent screening (ITAS) is a new method and can identify the exact carcinogen of a cancer patient. We applied ITAS for etiological diagnosis for AML to prove that cancer is preventable and curable.
Methods: Individual toxic agent screening (ITAS) is done by the medical toxicologist based on the Living – Eating – Working Together (LEWT) principle investigation to determine the toxic substances that the patient may have been exposed to. ITAS was applied to patients with a diagnosis of AML, acute lymphocytic leukemia, or myelodysplastic syndrome seen in the department of hematology at a regional Vietnamese hospital since 2020. They were followed during their treatment during and after chemotherapy.
Results: Forty-two cases were diagnosed with AML, acute lymphocytic leukemia, or myelodysplastic syndrome and had to consult with a medical toxicologist during treatment. Forty-one cases were associated with daily chemical exposure related to their daily habits or workplace. The chemical exposures included: benzophenone 4 in nail salon workers (4.7%), toluene or xylene in shoe workers (9.5%), benzene in polyurethane coatings or paint in furniture manufacturing workers (14.2%), and construction engineers (9.5%), benzyl acetate, benzisothiazolinone benzyl alcohol in fabric softeners or dryer sheets (45.2%), nonylphenol, benzyl compounds in liquid house cleaners (31%), essential oils (9.5%), printer ink (4.7%), polycyclic aromatic hydrocarbons (PAHs), benzene and carbonyls in incense (9.5%), nitrosamines in processed meats or preservative foods (11.9%). Other substances found in some cases were related to chemotherapy, antituberculosis medications, herbicides, insecticides, and tattoo ink. There were seven deaths during the follow-up of these patients. There was one case that had an unclear chemical exposure.
Conclusions: ITAS should be applied to all cancer patients to help determine the causal carcinogen for successful treatment. Cancer is curable and preventable.

KEYWORDS Individual toxic agent screening; etiologic treatment; cancer

teresa.vy75@gmail.com

270. Vitamin K inventory assessment during recent cluster of coagulopathy associated with synthetic cannabinoid use

Jemima Douge, Justin Arnold and Alexandra Funk
Florida Poison Information Center – Tampa, Tampa, FL, USA

Background: A new cluster of patients with severe coagulopathy was identified early December 2021. These patients required high doses of Vitamin K to reverse the coagulopathy. Within a short period of time additional patients were admitted with same chief complaints of severe bleeding or bruising. Based on preliminary verbal information from the treating hospitals, it was apparent that they were quickly depleting their Vitamin K inventory (oral and IV). Given the increase utilization during hospitalization, not knowing if the outbreak would widen and anticipating post discharge needs of Vitamin K, it became clear there was an imminent need to assess the availability of this antidote as we monitor the outbreak within the region.
Methods: The poison center region encompasses a total of 97 hospitals and free-standing emergency departments. As part of its ongoing disaster preparedness activities, the poison center often assesses inventory of specific antidotes in the region and maintains an updated log. This log contains contact information of each hospital pharmacy, buyer or manager, quantity, and expiration date of each antidote. Relying on these established relationships, 6 days into this new cluster of coagulopathy, the poison center quickly embarked in assessing the availability of Vitamin K, which was not previously monitored, throughout the region utilizing its tested methods of sending urgent emails and making phone calls. This approach helped rapidly assess the availability of Vitamin K in 16 county regions, the anticipated needs of hospitals, and encouraged interhospital sharing of the antidote.
Results: The Poison Center was able to generate a complete list of all hospitals in the region that reported having Vitamin K. The inventory accounted for oral and IV preparations, quantity available, and current and anticipated use in hospitals with affected patients. This process was ongoing. Information collected was included in the Vitamin K inventory log which was updated often and made available to hospitals inquiring as to the location of Vitamin K immediately. Initially the inventory assessment was done using a wide net approach and covered the full 16-county region, after which it was narrowed to the surrounding counties and included counties with large hospital systems. Eventually, it was limited to the county with the outbreak. Initially many hospitals were able to share Vitamin K in the region. Though as many hospitals depleted their inventory of Vitamin K, this assessment was expanded to assess critical information of about regional suppliers for hospitals to purchase additional vitamin K and the need for further strategies to ensure Vitamin K was obtained in a timely, efficient, and coordinated manner.
Conclusions: Poison centers should consider establishing partnerships and ongoing antidotes inventory assessments in preparation of sudden increased of demand for specific antidotes. While the Poison Center was not involved in process of transferring Vitamin k between hospitals, the regional inventory completed did provide a timely resource for local Department of Health and treating hospitals. This inventory assessment of Vitamin K proved to be very effective throughout the coagulopathy outbreak.

KEYWORDS Vitamin K inventory assessment; coagulopathy; spice outbreak

jdesir@tgh.org

271. Flumazenil infusion for acute benzodiazepine toxicity

Khizer Rizvi[a] and Joshua Nogar[b]

[a]Northwell, Queens, NY, USA; [b]NorthShore University Health System, Manhasset, NY, USA

Background: The use of flumazenil for acute sedative-hypnotic overdoses requires judicious patient selection. Patients who are chronic benzodiazepine users, or have a history of seizures, are poor candidates for flumazenil, as precipitous withdrawal and possibly seizures are well-described outcomes. Patients who are sedative-hypnotic naïve with pure benzodiazepine toxicity are ideal candidates for flumazenil. However, there is a paucity of literature on flumazenil infusions for severe prolonged benzodiazepine toxicity.
Case report: This is a case of a 55-year-old male with a past medical history of dementia, presenting with unresponsiveness after an acute alprazolam, lorazepam, and tramadol ingestion. The patient does not take these medications regularly, but the time and quantity of the ingestion was unknown. Per EMS, the patient was minimally responsive and bradypneic; intranasal naloxone 2 mg was administered twice without improvement. Upon Emergency Department (ED) arrival, 0.2 mg of intravenous flumazenil was given with mild improvement of symptoms. An hour later, patient had a recrudescence, requiring an additional 0.2 mg of flumazenil with improvement of the respiratory depression. Vital signs were HR 77, BP 130/78, RR 14, Temperature 97F, oxygen 93% on room air. Toxicology was eventually consulted, at which time the patient exhibited a second recrudescence. The patient was started on a flumazenil infusion (0.2 mg/h), and was titrated to clinical improvement of mental status. The flumazenil infusion was discontinued after 2 h without need for repeat dosing of reversal agents. He did not exhibit any withdrawal syndrome, and was medically cleared the following day.
Discussion: Flumazenil can serve as a useful reversal agent for the treatment of profound CNS depression due to benzodiazepine toxicity. In this case, the patient responded well to a brief flumazenil infusion, which was initiated after the patient required multiple doses of flumazenil. Although there is a lack of data on flumazenil infusions in acute overdoses, it may be a useful tool in the management of prolonged benzodiazepine toxicity, and acute withdrawal can be avoided with appropriate flumazenil dosing, close monitoring, and judicious patient selection

KEYWORDS Flumazenil; benzodiazepine; infusion

krizvi@northwell.edu

272. Toxicokinetics of metformin overdose treated with CVVHDF

Brian Lewis[a], Daniel Brooks[b], Christopher Dion[a] and Courtney Schwebach[c]

[a]Banner University Medical Center – Phoenix, University of Arizona College of Medicine – Phoenix, Phoenix, AZ, USA; [b]Banner Poison and Drug Information Center, Phoenix, AZ, USA; [c]Creighton University School of Medicine/Maricopa Emergency Medicine Residency, Phoenix, AZ, USA

Background: Metformin is the most commonly used diabetes medication and at supratherapeutic levels can result in a severe type-A metabolic lactic acidosis known as metformin-associated lactic acidosis (MALA). Treatment of MALA includes aggressive fluid resuscitation, supporting blood pressure and correcting acidosis. Renal replacement therapy (RRT), usually hemodialysis (HD) is recommended in severe cases with refractory acidosis (with elevated lactate), altered mental status, or shock. To our knowledge, this is the second report of metformin half-life during treatment with continuous veno-venous hemodiafiltration (CVVHDF).
Case report: A 53-year-old man died following a reported acute on chronic ingestion of 80 g of his metformin tablets resulting in severe, refractory shock and MALA. His peak serum metformin concentration was 53 mcg/mL (therapeutic range 1–2 mcg/mL), peak lactic acid concentration was 49.7 mmol/L, and arterial pH nadir was 7.06. Serial serum metformin concentrations were obtained while on RRT; both HD and CVVHDF. The switch from HD to CVVHDF was done due to staffing shortages during the COVID-19 pandemic. The patient died despite aggressive therapy with renal replacement therapy and multiple vasopressors on hospital day five. Serial metformin concentrations during CVVHDF suggested a half-life of 33-h.
Discussion: Hemodialysis has been reported to clear metformin at a rate greater than 200 mL/min and continuous venous-venous hemofiltration (CVVH) at greater than 50 mL/min. In this case, metformin levels appear to follow first-order elimination kinetics during CVVHDF with an estimated half-life of 33 h. Comparatively, metformin has a half-life of 4.7–5.5 h during HD. To our knowledge, this is the second report of estimated metformin half-life while using the CVVHDF form of continuous renal replacement. The previous case report measured a half-life of 16.5 h on CVVHDF. This case report shows CVVHDF decreases half-life of metformin and provides first order elimination in the setting of overdose.
Conclusions: The early initiation of HD appears warranted but prognostic indicators have not been well established. In the absence of HD availability, other forms of RRT (e.g., CCVHDF) can be used and may provide first-order elimination of metformin.

KEYWORDS Metformin; CCVHDF; MALA

brianglewis14@gmail.com

273. Variables impacting follow-up rates for healthcare facility referral at a poison control center

Nicole McElroy[a], Jeanette Trella[b] and Anthony Jaworski[b]

[a]Children's Hospital of Philadelphia, Philadelphia, PA, USA; [b]The Poison Control Center at Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background: Case follow-up is imperative in ensuring continuity of care and provides complete clinical information to the National Poison Data System. At the Philadelphia Poison Control Center (PCC), a follow-up policy is in place that states any patient referred to a healthcare facility (HCF), requires timely follow-up. The objective of this quality improvement initiative was to identify and describe variables that may affect rate and time to follow-up in cases referred to an HCF.
Methods: This was a retrospective review of a regional poison center's cases for a 1-month period. All cases involving patients referred to an HCF were included. Cases were excluded if the patient or HCF contacted the poison center prior to poison center follow-up, the patient denied follow-up, or if the case was transferred to a different PCC. Data collected included case demographics (age, exposure reason, exposure route) and follow-up documentation (date and time of follow-up). Endpoints included markers of policy compliance, which included: documentation of nearest HCF, emergency department (ED) case pass-off, 911 referral, home/HCF outreach. Time to follow-up was

calculated and rate of follow-up was assessed with respect to reason for exposure and patient age.
Results: A total of 245 cases were analyzed. Fifty-nine percent of cases involved adults. For all cases, the reason for exposure was most commonly unintentional-general (33.5%) followed by intentional-suspected suicide (16.3%). The overall rate of follow-up was 42.8%, with a median time to outreach of 4.4 h. Time to outreach did not appear to differ significantly across reasons for exposure or age of patient. The highest rate of follow-up was in pediatric patients with unintentional-general exposures (76.1%). The portion of the policy with least compliance was documentation of nearest HCF, which occurred in 38 cases (15.5%). Further, of the 38 cases in which nearest HCF was known, the corresponding ED was notified proactively approximately 55% (21/38 cases) of the time. Among the 21 cases where the ED was notified, pass-off to a healthcare professional was documented in the PCC narrative 85.7% of the time.
Conclusions: The data from this review suggest presence of barriers to follow-up and need for policy optimization and education. Acuity stratification may allow for case prioritization and promote adherence to policy. The observed trend for higher follow-up among pediatric cases may be due to perceived fragility and vulnerability of pediatric patients. It may also be due to lack of comfort connecting adults with intentional exposures to HCFs. A larger study involving other poison centers would confirm these results. Additionally, a survey of specialists in poison information should be conducted to identify gaps in education and investigate the reasons for discrepancies.

KEYWORDS Poison control centers; quality improvement; policy optimization

n-mcelroy@onu.edu

274. Watch for high tides, but maybe at home: GLP-1 receptor agonist exposures reported to NPDS

Jared Cavanaugh[a] and Stephanie Hon[b]

[a]California Northstate University College of Pharmacy, Elk Grove, CA, USA; [b]Georgia Poison Center/Grady Health System, Atlanta, GA, USA

Background: Glucagon-like peptide 1 (GLP-1) agonists are increasingly prescribed agents for blood glucose control and cardiovascular protection in diabetics as well as obesity. The mechanism for the glucose lowering effects of GLP-1 agonists is glucose-dependent with therapeutic use, and the risk of hypoglycemia is very low, however the risk of hypoglycemia and other effects after poisoning are not well described. This retrospective observational study of National Poison Data System (NPDS) data were performed to evaluate the adverse effects, therapies received, and outcomes for patients exposed to GLP-1 receptor agonists.
Methods: The NPDS was queried for all single substance GLP-1 receptor agonist exposures from January 1, 2004 to December 31, 2019. Data abstracted included patient age, gender, chronicity, medical outcome, management site, effects, and treatments. Descriptive statistics were used to analyze the data.
Results: There were 1755 acute or acute-on-chronic GLP-1 receptor agonist exposures reported from 2004 to 2019. Routes of exposure were predominately parenteral ($n = 1398$, 79.6%), followed by ingestion ($n = 236$, 13.5%), dermal ($n = 65$, 3.7%), and ocular ($n = 26$, 1.5%) exposures. Seventy-two percent ($n = 1263$) of exposures were managed at home, with 9.1% ($n = 160$) cases referred into a healthcare facility and 16.9% ($n = 297$) already in or enroute to a healthcare facility. Ages ranged from 1 month to 92 years with 1651 (94.1%) adults >18 years old and 73 (4.2%) exposures in children ≤6; and 1311 (70%) of patients were female. Reasons for exposure were predominately unintentional therapeutic errors ($n = 1377$, 78.5%), followed by adverse reaction ($n = 102$, 5.8%). Only 2% ($n = 37$) of exposures were due to suspected suicide. Of the 1755 exposures, 727 (41.4%) were followed to a known outcome. The majority of cases resulted in no effect ($n = 418$, 57.5%) or minor effects ($n = 220$, 30.2%), with few cases resulting in moderate ($n = 84$, 11.5%) or major effects ($n = 5$, 0.7%). No deaths were reported. The most common symptoms reported among cases followed to a known exposure ($n = 727$) include nausea ($n = 144$, 19.8%), vomiting ($n = 108$, 14.9%), hypoglycemia ($n = 42$, 5.8%), headache ($n = 27$, 3.7%), dizziness/vertigo ($n = 27$, 3.7%), abdominal pain ($n = 26$, 3.6%), diarrhea ($n = 16$, 2.2%), dermal irritation ($n = 12$, 1.7%), and pruritis ($n = 10$, 1.4%). Treatments provided among cases followed to a known outcome were food/snack ($n = 243$, 33.4%), dilute/irrigate/wash ($n = 130$, 17.9%), intravenous fluids ($n = 57$, 7.8%), antiemetics ($n = 40$, 5.5%), and intravenous glucose >5% ($n = 17$, 2.3%). Other notable therapies included vasopressors ($n = 3$), octreotide ($n = 2$), and glucagon ($n = 1$).
Conclusions: The majority of cases were managed at home and had either no or minor effects. The effects experienced were mostly an extension of the therapeutic adverse effects of gastrointestinal distress. Few exposures resulted in moderate or major outcomes, however 5.8% of cases followed to a known outcome resulted in hypoglycemia. Limitations to this study include the retrospective nature and possible incomplete, miscoded, or missing data. While this study describes common effects and treatments with GLP-1 receptor agonist exposures, further studies may better characterize risks associated with hypoglycemia to enhance triage of exposures.

KEYWORDS GLP-1; antidiabetic; hypoglycemia

jaredacavanaugh@gmail.com

275. Bigger isn't always better: diagnosing obstructions in water bead ingestions

LaDonna Gaines and Amy White

Alabama Poison Information Center, Children's of Alabama, Birmingham, AL, USA

Background: Water beads are popular toys that have been around for almost 20 years. While toxicity has historically been rare, there remains a risk for airway or bowel obstruction. The most popular brand of water beads does not have a choking hazard disclaimer. The likelihood of obstruction depends on several factors including the number of beads, the size of the beads, and age of the child. The goal of this report is to demonstrate a case of severe toxicity requiring surgical exploration following pediatric water bead ingestion.
Case report: A 2-year-old female was found with a large quantity of water beads that had expanded after exposure to water. Mother was unsure how many were available and there was no reliable method to determine how many were missing. The child was initially asymptomatic. However, due to the unknown amount ingested, she was referred to an emergency department for chest and abdominal imaging. Upon arrival, an x-ray revealed possible epiglottitis. The child was transferred to a pediatric hospital. Emergent flexible fiberoptic scope demonstrated a patent airway and no concern for epiglottitis or airway foreign body. Seven hours after the exposure, the child was noted to have an increase in drooling. No respiratory or other gastrointestinal issues were noted and she was admitted for observation. A few hours later, she started having emesis with abdominal discomfort. Abdominal x-ray revealed air/fluid levels consistent with bowel obstruction. She continued to have emesis and was

subsequently taken to surgery where five (3 plus 2 halves) water beads, 20–30 mm in size, were laparoscopically removed. Over the next 2 days she was slowly advanced to a normal diet and received ketorolac for pain control. She was ultimately discharged after a 4 day hospital stay.
Discussion: Previous work suggests that obstruction due to water beads expansion may take several hours up to 3 days to manifest. The most commonly reported symptoms are emesis, constipation, abdominal tenderness or distension. Although they begin at 2 mm, water beads can reach up to 65 mm (the size of a racquet ball). A recent literature review found 43 cases of water bead induced bowel obstruction. Similar to our case, most required surgical or gastrointestinal intervention. Interestingly, most of the 43 water beads were unable to be identified on abdominal imaging which differs from this report. If left untreated, a bowl obstruction can cause many dangerous complications, which can include: bowel perforation, abscess, sepsis, and even death.
Conclusions: This report adds to the body of literature regarding possible bowel obstruction from water absorbent beads. Our case and others emphasizes that symptoms may take several hours to days to become apparent. Patients with an unknown amount ingested or a young age may benefit from close follow-up.

KEYWORDS Water beads; bowel obstruction; imaging

ladonna.gaines@childrensal.org

276. Elective cannulation to veno-arterial extracorporeal membrane oxygenation (VA-ECMO) in a teenager with vasoplegia following amlodipine ingestion

Merritt Tuttle[a], Lauren Wells[b], Justin Corcoran[c] and Jillian Theobald[c]

[a]Children's Hospital, Milwaukee, WI, USA; [b]Wisconsin Poison Center, Milwaukee, WI, USA; [c]Medical College of Wisconsin, Milwaukee, WI, USA

Background: In 2019 calcium channel blockers accounted for 4.84% of pharmacologic fatality reports. Amlodipine constituted 29% of cardiovascular drug fatalities. In overdose, amlodipine may cause profound hypotension requiring a multimodal treatment approach. ECMO has rarely been implemented as salvage therapy in amlodipine toxicity with cardiovascular collapse. Timing of ECMO initiation in these patients varies.
Case report: A 61.4 kg 17-year-old female presented to an emergency department (ED) 1–2 h after attempting suicide by ingesting amlodipine and reportedly no other substance. She took an estimated 740 mg based on pill count. She received 50 g of activated charcoal in the ED and insulin titrated up to a maximum of 75 U/h. She had acute kidney injury and lactic acidosis. An arterial blood gas showed pH 6.97, pCO_2 70 mmHg, bicarbonate 16.4 mmol/L. She became progressively hypotensive, received two liters of normal saline, and required vasoactive support with norepinephrine and vasopressin. Due to worsening encephalopathy and hypoxemia, she was intubated. She suffered cardiac arrest with pulseless electrical activity and was resuscitated with two doses of epinephrine. Despite the addition of continuous phenylephrine and epinephrine, she remained hypotensive with mean arterial pressure 30–40 mmHg. She received 355 mL intravenous (IV) lipids. Given refractory hypotension, she was electively cannulated onto VA-ECMO. Her vasoactive medications included epinephrine 0.4 mcg/kg/h, norepinephrine 1.0 mcg/kg/min, phenylephrine 5.0 mcg/kg/min, and vasopressin 0.5 milliunits/kg/min. She received a dose of methylene blue prior to transport to a pediatric cardiac intensive care unit and a second dose, 140 mg, 2 days later. She received IV fluids and intermittent blood products. She was decannulated from ECMO on hospital day six. A serum amlodipine level collected on hospital day 5 was 190 ng/dL (reference range 2–25 ng/dL). She tolerated gradual weans in vasoactive support and was extubated on day 10. Brain magnetic resonance imaging (MRI) on day 11 showed nonspecific abnormalities in the bilateral globi pallidi without other evidence of anoxic brain injury. She had proprioceptive deficits in the upper extremities, findings possibly reflective of true brain injury in the setting of the MRI. Neuropsychological testing on day 18 demonstrated deficits in processing speed and attention and weakness in visual-spatial and focal language tasks. She was transferred to a mental health facility on day 29.
Discussion: This is one of few reports that demonstrate the effectiveness of VA-ECMO in facilitating recovery from refractory vasoplegia after overdose. Early consideration of ECMO in patients who sustain cardiovascular collapse as a result of poisoning is important because outcomes are better in patients electively cannulated versus those who undergo cannulation simultaneous with cardiopulmonary resuscitation. Patients with few comorbidities, namely pediatric patients, are likely to have the most successful outcomes following poisoning and subsequent ECMO support.
Conclusions: Clinicians should conduct prospective studies investigating early, planned ECMO cannulation for otherwise healthy patients, such as children, poisoned by toxicants that cause cardiopulmonary failure and/or refractory vasoplegia.

KEYWORDS Amlodipine; ECMO; critical care

mtuttle@mcw.edu

277. Severe hypermagnesemia from ingestion of (not so) trace mineral drops leading to respiratory failure and requiring hemodialysis

Ryan Fuchs[a], John Litell[b], Jill Topeff[c], Matt Spanier[d] and Jon Cole[b,c]

[a]Healthpartners Regions Hospital, St. Paul, MN, USA; [b]Department of Emergency Medicine, Hennepin Healthcare, Minneapolis, MN, USA; [c]Minnesota Poison Control System, Minneapolis, MN, USA; [d]Department of Critical Care, Abbott Northwestern Hospital, Allina Health, Minneapolis, MN, USA

Background: Nonprescription magnesium (Mg) preparations are marketed as cathartic agents and for relaxation and mood effects. Acute Mg toxicity following unintentional exposure is rare and typically occurs following ingestion or gargling of high-concentration Epsom Salts or chronic use of Mg citrate solutions in patients with renal dysfunction. We report a case of accidental Mg poisoning in a patient with normal renal function, treated successfully with hemodialysis.
Case report: A 58-year-old man with history of opioid-induced constipation presented to the emergency department (ED) via ambulance complaining of abdominal pain and difficulty breathing shortly after drinking an eight-ounce bottle of Trace Mineral Drops. He mistook this for a Mg citrate cathartic product that he often used for severe constipation. The product he accidentally consumed is marketed as a source of non dietary trace minerals and is dosed by the drop. Each 2.5 mL serving contains the following metals dissolved in water: chloride 650 mg, magnesium 250 mg, sulfate 40 mg, sodium 5 mg, potassium 3 mg, lithium 1.5 mg, boron 1 mg, in addition to a variety of "trace" elements. Based on self report, the patient ingested approximately 25 g of

elemental magnesium. Shortly following ED arrival he rapidly developed confusion and respiratory depression. Initial vital signs included blood pressure 174/79, heart rate 101, SpO_2 40% on room air. He became unresponsive, did not respond to naloxone 2 mg IV, and was intubated. Electrocardiogram showed PR 242 ms, QRS 106 ms, QTc 542 ms, and bizarre T wave morphology. Initial laboratory studies revealed serum Mg 15 mg/dL (ref. range 1.6–2.2 mg/dL), chloride 121 mEq/L, creatinine 0.87 mg/dL. He was given isotonic IV fluids, furosemide, chlorothiazide, and calcium gluconate. Serum Mg increased to 23.2 mg/dL approximately 4 h after ingestion. The significant rise in Mg despite intervention prompted emergent hemodialysis for 4 h at a blood flow rate of 400 mL/min. He experienced mild hypotension during dialysis, which improved with IV fluid administration. He had no dysrhythmias and did not require vasopressors. After dialysis, serum Mg decreased to 5.7 mg/dL and continued to fall. Recurrent hypotension and bradycardia developed post dialysis and resolved with calcium gluconate. The patient was extubated and after normalized Mg levels was discharged.

Discussion: Often claiming broad health benefits, dietary supplements are not FDA regulated, which may place them at high risk for severe morbidity in overdose. Despite the name, Trace Mineral Drops contain high concentrations of Mg salts. Mg toxicity has many known severe clinical consequences, including respiratory failure, encephalopathy, cardiac conduction disturbances, and death. Hemodynamic effects can be temporized with calcium administration. Forced diuresis (if normal renal function) and hemodialysis enhance elimination, reduce the risk of dysrhythmia and hemodynamic instability, and improve time to resolution of weakness and respiratory failure.

Conclusions: Ingestion of nonprescription preparations can cause hypermagnesemia with severe clinical effects. Cardiopulmonary support, calcium administration, and enhanced elimination including hemodialysis may be necessary.

KEYWORDS Magnesium; dialysis; dietary supplement

ryan.fuchs@hcmed.org

278. Unintentional pediatric ingestion of brexpiprazole

Bryan Kuhn[a] and Kaitlin Ryan[b]

[a]Banner Poison and Drug Information Center, Phoenix, AZ, USA; [b]Banner University Medical Center Phoenix, Phoenix, AZ, USA

Background: Brexpiprazole (Rexulti®) is an FDA-approved oral atypical antipsychotic with partial agonist activity at serotonin 5-HT1A and dopamine D2 receptors, and antagonist activity at serotonin 5-HT2A receptors. A specific toxic dose has not been established and one case of a pediatric exposure with brexpiprazole exists in the current medical literature. We report a 16-month-old girl with persistent neurologic symptoms after acute ingestion of brexpiprazole.

Case report: A 16-month-old, 11.5 kg girl was brought to an emergency department approximately 30 min after being found with an open bottle of her mother's 4 mg brexpiprazole. Two tablets appeared to be missing and presumed ingested. She was reported to be agitated and more drowsy than usual on arrival. Approximately 45 min later, she had continued somnolence, but was easily arousable and interacting normally. Her physical exam was non focal, and laboratory and imaging studies were unremarkable. The recommendation was made by the poison center to continue observation and cardiac monitoring for a minimum of 4–6 h. Though the patient remained minimally somnolent, she was discharged to home 4 h after the ingestion time. The following morning, the patients father called the poison center to report the patient was persistently lethargic with poor oral intake and had developed bilateral hand tremors. The recommendation was made to have the child return to the emergency department. She was subsequently admitted to a pediatric floor for observation where she continued to be somnolent with poor oral intake and bilateral hand tremors when reaching for objects. Treatment was supportive. The father was able to confirm that no more than one tablet of 4mg brexpiprazole was missing from the pill bottle and that no further ingestion had likely occurred since then. By the following morning, approximately 48 h after the ingestion time, the patient had resolved all neurologic symptoms and was discharged to home.

Discussion: Unlike other atypical antipsychotics that primarily antagonize dopamine D2 receptors brexpiprazole is a partial agonist at 5-HT1a, D2, and D3 receptors, and antagonist at other serotonin and dopamine receptors as well as alpha, histamine, and muscarinic receptors. Adverse effects commonly associated with therapeutic doses include somnolence, akathisia, and tremor. Overdose effects are anticipated to be an extension of adverse effects following therapeutic administration, though are minimally reported in the pediatric literature.

Conclusions: Brexpiprazole is an atypical antipsychotic with multifactorial mechanisms of action not well described in the pediatric literature. We report a 16-month-old girl with persistent neurologic symptoms after acute ingestion of brexpiprazole.

KEYWORDS Brexpiprazole; pediatric; exposure

bryan.kuhn@bannerhealth.com

279. A daily mistake: simple therapeutic errors with methotrexate can lead to serious consequences

Carrie Oakland[a], Ryan Fuchs[b], Ted Gray III[a], Nathan Kunzler[a] and Jon Cole[a]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]Hennepin County Medical Center, Minneapolis, MN, USA

Background: Methotrexate (MTX) is an antimetabolite chemotherapeutic with many indications including a treatment of certain malignancies, rheumatoid arthritis, and severe psoriasis. There is significant risk of dosing errors with methotrexate because of the unusual frequency of dosing and cases with accidental daily dosing are common. Since MTX is specific for the S phase of the cell cycle, actively proliferative tissues are more susceptible to the effects of MTX leading to significant side effects like nausea, vomiting, stomatitis, renal failure, pancytopenia, sepsis, and cirrhosis that can lead to life threatening consequences. The purpose of this abstract is to present five cases of repeated supratherapeutic MTX poisoning. 74-year-old (yo) man who took 10 mg MTX three times per day for 2 weeks instead of three times per week. 70 yo man who took 15 mg MTX daily for 16 days instead of weekly. 63 yo woman who took 15 mg MTX daily for 8 days instead of weekly. 65 yo woman who took 5 mg MTX daily instead of 25 mg weekly. 60 yo man who took 15 mg MTX daily for 4 days instead of weekly.

Results: (1) Patient developed stomatitis, oropharyngeal edema, AST 49 and ALT 159, SCr 1.31, platelets 30, wbc 0.4, fever, confusion, hallucinations. He was treated with alkalization of urine, vancomycin switched to cefepime and trimethoprim-sulfamethoxazole, granulocyte colony-stimulating factor (G-CSF), leucovorin, and oxygen. Patient was stable by day 9. (2) Patient developed tachycardia, stomatitis, nausea, diarrhea, pancytopenia-platelets 32, ANC 0.2, WBC 0.7, Hgb 6.5, SCr 5.42, and oliguria. He was treated with alkalization of urine, 1 unit of FFP, G-CSF, and Leucovorin. Patient was stable on day 11. (3) Patient developed oral and throat irritation. Patient was treated with leucovorin and symptoms cleared in 3 days. (4) Patient developed tachycardia, hypotension, rash, anorexia, nausea, vomiting,

diarrhea, dehydration, dysphagia, AST 179 ALT 140, Bilirubin 2.8, hemoglobin 6.5, ANC 600, ALC 200, platelets 5, and fever. Patient was treated with leucovorin, G-CSF, cefepime, Unasyn, steroid taper, and blood transfusion. Symptoms and counts improved on day 7. (5) Patient developed stomatitis, noninfected ulcerous skin lesions, and swelling of the tongue. They were treated with alkalization of urine, iv fluids, and leucovorin. The patient was discharged on day 2. The patients were clinically improving and deemed stable by the personnel of the Minnesota Poison Control System.

Discussion: Chronic MTX therapeutic misadventures have been previously reported in the literature, however these cases highlight the significant effects that can be seen with a simple daily dosing error. Patients are at risk for decompensation days to weeks after their last dose of MTX. In these cases, all patients were treated with leucovorin until MTX level resulted at <0.04 mcmol/L. Several patients developed neutropenia, and were treated with the G-CSF with recovery in the cell counts. Patients with fevers were treated with broad spectrum antibiotics. The management of these cases can be complex and require multidisciplinary coordination of care with hematology/oncology and infectious disease.

Conclusions: Excellent supportive care is essential in cases with MTX dosing errors. All of our cases were fortunate to have positive outcomes, but as simple dosing errors can prove fatal, these cases demonstrate the importance of patient counseling by the health care team.

KEYWORDS Methotrexate; therapeutic misadventure; repeated supratherapeutic ingestion

carrie.oakland@hcmed.org

280. Double trouble: repeat salicylate overdose in a single adolescent patient treated with varied renal replacement therapies

Nathan Kunzler[a], Ryan Fuchs[b], Abigail Schnaith[c], Carrie Oakland[a], Alexandru Ulici[a], Abby J. Montague[a], Jon Cole[a] and Anne Kouri[d]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]Hennepin County Medical Center, Minneapolis, MN, USA; [c]Department of Pediatrics, University of Minnesota, Minneapolis, MN, USA; [d]Division of Pediatric Nephrology, Department of Pediatrics, University of Minnesota Medical School, Minneapolis, MN, USA

Background: Salicylate overdose is a common toxicological problem. In severe cases, extracorporeal removal is recommended by consensus guidelines to limit morbidity and mortality. Traditional recommendations are to use intermittent hemodialysis (IH) rather than continuous renal replacement therapy (CRRT) to increase the efficiency of salicylate clearance. Here we report a case series of one patient who overdosed on large amounts of aspirin twice within 2 months, once treated with CRRT and once with IH.

Case series: A 15-year-old patient presented to a tertiary care center after intentional ingestion of a reported 162 g of aspirin. Initial salicylate concentration [ASA] was 99 mg/dL. The patient presented with tinnitus, tachycardia, diaphoresis, and vomiting. He was given 50 mEq of IV bicarbonate. Due to local limitations this facility was only able to offer CRRT and not IH. CRRT was initiated and after discussion with the ICU and nephrology teams a blood flow rate of 270 mL/min was selected based on a weight of 105.5 kg and height of 185.5 cm. [ASA] fell to <40 mg/dL over the next 12 h. Concentrations continued to decrease and CRRT was discontinued after a total of 28 h. The patient was transferred for mental health care on hospital day 5. Approximately 2 months later, this patient presented to a different hospital after ingesting 81 g of aspirin. The patient presented with abdominal pain, diaphoresis, tachycardia, and tinnitus. Initial [ASA] was 46 mg/dL. An isotonic sodium bicarbonate infusion was started and they were admitted to the pediatric intensive care unit. Despite the initiation of a sodium bicarbonate infusion, [ASA] rose to 82.4 mg/dL 2 h later, then 93.2 mg/dL 2.5 h after that measurement. IH was initiated 5 h after arrival at a blood flow rate of 425 mL/min for 15.5 h. They did not require any additional renal replacement therapy.

Discussion: In this small case series our patient, managed with two distinct extracorporeal removal strategies, did well after each admission. Salicylate concentrations in this case fell significantly faster on intermittent hemodialysis than continuous renal replacement therapy even with CRRT flow rates that were intentionally increased. Additionally, the time on renal replacement therapy was significantly less with IH and the time spent with potentially toxic levels of serum salicylates was also shorter, though the amount ingested in the second case was also less.

Conclusions: In this case series where a single patient served as their own comparison, IH cleared salicylate more quickly than CRRT, consistent with traditional teaching in this case. CRRT, however, was still an effective therapy, and may be considered when resources limit access to intermittent hemodialysis.

KEYWORDS Aspirin; intermittent hemodialysis; continuous renal replacement therapy

carrie.oakland@hcmed.org

281. A relaxing trend: trends and characteristics of skeletal muscle relaxant exposures reported to NPDS

Stephen Thornton[a] and Michael Darracq[b]

[a]Kansas Poison Control Center, Kansas City, KS, USA; [b]University of California-San Francisco-Fresno, Fresno, CA, USA

Background: Skeletal muscle relaxants are a disparate group of pharmaceuticals. Some are notable for their abuse potential, while others have the potential to cause significant clinical effects if taken in excess. With the pressure to reduce the use of opioid analgesics, skeletal muscle relaxants could be used as alternative analgesic agents, potentially leading to increased exposures and misuse/abuse. This study aimed to evaluate the characteristics and trends of single agent skeletal muscle relaxant exposures reported to National Poison Data System (NPDS) from 2014 to 2021.

Methods: This was a cross sectional study consisting of NPDS data collection utilizing quantitative data for the period of January 1, 2014 to December 31, 2021. The NPDS was queried to identify all single agent human exposures for cyclobenzaprine, carisoprodol, metaxalone, and methocarbamol that were followed to a known outcome. These substances were selected as they carry specific FDA indications for acute, painful musculoskeletal conditions. All data entered into NPDS was collected and analyzed using Microsoft Excel (Microsoft Corp., Redmond, Washington, 2010).

Results: There were 32478 cases identified with 99.6% ($n = 32,347$) resulting from oral exposures. Sixty-two percent ($n = 20,136$) were female. Average age was 23.1 years (SD 19.5) but cyclobenzaprine cases were younger (average age of 16.6 years, SD 20.3) compared to the other substances (35.5 years, SD 18.0). Thirty-three percent ($n = 10,671$) of cases involved pediatric patients (age <19 years). Total cases declined every year from 4980 cases in 2014 to 2981 cases in 2021. Carisoprodol saw the

largest decline, going from 1421 cases in 2014 to 265 cases in 2021 while methocarbamol saw a mild increase from 545 cases in 2014 to 623 in 2021. Cyclobenzaprine was the most commonly encountered agent, comprising 65% ($n = 21,184$) of all cases, while metaxalone was least encountered with 2.6% ($n = 859$) of cases. Intentional ingestion–suspected suicide was the most common exposure reason with 17,092 (53%) cases. Methocarbamol had the highest rate of intentional ingestion-suspected suicide with 58% ($n = 2648$) of cases. Intentional ingestion-misuse/abuse was reported in 8.9% of cases ($n = 2908$) but was more common in carisoprodol cases, accounting for 21% ($n = 1243$) of cases. Cyclobenzaprine had the lowest reported misuse/abuse rate at 5.9% ($n = 1241$). Moderate or major clinical outcomes occurred in 31% ($n = 10,148$) of all cases, with 44% ($n = 2569$) of carisoprodol cases resulting in moderate or major outcomes. Twenty-eight percent ($n = 9115$) of cases were admitted to a health care facility. There were 26 deaths reported, with 15 deaths attributed to cyclobenzaprine and 9 to carisoprodol. Tachycardia ($n = 7977$), coma/CNS depression ($n = 5525$) and agitation ($n = 2946$) were the most common clinical effects reported. Benzodiazepines were given in 2764 cases (8.5%) and intubation was performed in 1718 cases (5.2%)

Conclusions: Single agent exposures to skeletal muscle relaxants declined from 2014 to 2021. Intentional exposures remained common with tachycardia and CNS effects most commonly described. Significant morbidity was not common though deaths did occur. Though carisoprodol saw a steep decline in reported cases, it was still most associated with misuse/abuse and significant clinical outcomes. Cyclobenzaprine trend towards involving younger patients and methocarbamol's association with suicide attempts warrant further investigation.

KEYWORDS Cyclobenzaprine; carisoprodol; methocarbamol

sthornton@kumc.edu

282. Elimination half-life of isopropanol with continuous venovenous hemodialysis: a case report

Emily Kershner[a,b], Catherine Dong[a,b], Natasha Tobarran[a,b], Andrew Chambers[a,b], Melody Siff[a], Kirk Cumpston[a,b], Yahya Imran Fatani[a], Rutherfoord Rose[a,b] and Brandon Wills[a,b]

[a]Virginia Commonwealth University Medical Center, Richmond, VA, USA; [b]Virginia Poison Center, Richmond, VA, USA

Background: Isopropanol is metabolized into acetone by alcohol dehydrogenase (ADH). Approximately 80% is excreted renally as acetone, whereas 20% is renally eliminated unchanged. Prior studies have demonstrated that isopropanol metabolism follows first-order kinetics with half-lives ranging from 3 to 7.3 h. Factors that may contribute to this variability include genetic expression of ADH, baseline liver disease, gender, age, and the presence of co-ingestions. Hemodialysis may be indicated in severe toxic ingestions manifesting as coma and hypotension. There is limited data on isopropanol elimination kinetics in patients undergoing hemodialysis or continuous renal replacement therapy (CRRT). We present a case in which isopropanol elimination half-life was calculated from a patient who underwent CVVHD.

Case summary: 29-year-old female with a history of depression was found unresponsive with a suicide note surrounded by empty bottles of sangria, isopropanol, and ibuprofen. On arrival to the emergency department, she had a blood pressure 111/53 mmHg, heart rate 143 bpm, respirations of 21 per minute, oxygen saturation of 98% on room air, and temperature of 36.7 °C. She had a GCS of 3 with hematemesis and was promptly intubated for airway protection. Initial labs were notable for ethanol concentration of 51 mg/dL and a urine drug screen positive for cannabinoids. An Acetest was negative for serum ketones. A venous blood gas, comprehensive metabolic panel and complete blood count were within normal limits. Acetaminophen and salicylate concentrations were undetectable. Fomepizole was not given. Seven hours post-presentation, she had a serum isopropanol concentration of 361 mg/dL and acetone concentration of 35 mg/dL. Ethanol, ethylene glycol and methanol were undetectable at that time. She became more hypotensive and was started on peripheral vasopressors. She was then transferred for initiation of continuous venovenous hemodialysis (CVVHD) in the setting of coma and hypotension. CVVHD was continued for a total of 34 h using Nxstage CRRT with Purema H Filter at dialysate flow of 2.5 L/h and blood flow of 250 mL/min. Serial isopropanol concentrations were obtained. The patient was eventually weaned off vasopressors, extubated, and transferred to psychiatry. Assuming first-order kinetics, isopropanol elimination half-life was calculated using the slope determined by linear regression. Prior to CVVHD, the isopropanol half-life was estimated to be 10 h and an 2.7 h with CVVHD.

Discussion: Isopropanol ingestion can lead to significant coma and hypotension, which has been proposed as an indication for enhanced elimination with hemodialysis. In the case presented, intermittent hemodialysis was unable to be performed due to hypotension so CVVHD was initiated. There are no prior reports in the literature regarding the elimination half-life of isopropanol with CVVHD.

Conclusions: We describe a case of severe isopropanol toxicity that received CVVHD with serial isopropanol concentrations obtained. CVVHD increased the half-life elimination rate of isopropanol by factor of 3.7 and prevented further cardiotoxicity and CNS depression.

KEYWORDS Isopropanol; half-life; enhanced elimination

Emily.Kershner@vcuhealth.org

283. Twist of phate: severe toxicity after an intentional acephate ingestion

Brian Whitworth[a], Sukhshant Atti[b], Brooke Blackwell[c] and Erin Ryan[a]

[a]Alabama Poison Information Center, Birmingham, AL, USA; [b]University of Alabama at Birmingham, Birmingham, AL, USA; [c]Alabama Poison Information Center, Children's of Alabama, Birmingham, AL, USA

Background: Acephate (AP) is an organophosphate (OP) thought to cause less severe toxicity when compared to other OP compounds in human exposure. We discuss an intentional AP ingestion causing severe toxicity.

Case report: A 29-year-old female arrived to the emergency department (ED) after being found unresponsive in a car with an empty 340 g container containing 50% AP. Initial vital signs were sinus tachycardia (140 bpm), BP 123/52, RR 10, O2 73% on room air, and temperature 87.8 °F. On exam, she was "comatose" with "pinpoint pupils," along with "shallow respirations and scattered rales." The patient had ligature marks around the right side of her neck possibly consistent with strangulation. Initial glucose was 358 mg/dL. In the ED, the patient was successfully intubated using succinylcholine (100 mg) and etomidate (20 mg). The patient's epiglottis and upper airway were noted to be edematous upon direct laryngoscopy; it was unclear if strangulation and/or AP contributed to this finding. Shortly after intubation, the patient developed asystolic cardiac arrest and was

successfully resuscitated with two rounds of CPR. A total of 10 mg of atropine was then administered for pulmonary secretions. Propofol was started for concern for non-convulsive status epilepticus despite diazepam (10 mg total) and midazolam (4 mg) administration. Rewarming was initiated. Labs were notable for potassium 2.0 mEq/L, calcium 7.5 mg/dL, bicarbonate 16 mEq/L, anion gap 19 mEq/L, AST 122U/L, ALT 109U/L, WBC 25.2 × 109/L, and ethanol 69 mg/dL. Chest radiography demonstrated aspiration and left lower lobe atelectasis. EKG showed sinus tachycardia and prolonged QTc (566 ms). The patient was transferred to the ICU at another facility, where she developed symptomatic sinus bradycardia. Despite additional doses of atropine, the patient arrested for a second time and was resuscitated successfully with CPR. Pralidoxime (1 gm IV) was administered along with an atropine infusion and vasopressor support (norepinephrine (2 mcg/kg/min) and epinephrine (0.32 mg/min)). On day two, the atropine infusion was weaned, along with vasopressors. On day three, secretions were manageable with intermittent suction and sedation was weaned. The patient was extubated on day four. Cholinesterase activity levels were recommended but not obtained. She was discharged home on day eight with no residual effects. The patient admitted to ingesting AP upon recovery.

Discussion: Toxicity of AP is dependent upon its conversion to the metabolite methamidophos (MP), a more potent inhibitor of cholinesterase than AP. In mammals, MP formation is mediated by the enzyme carboxyamidase. However, in turn, MP inhibits enzyme carboxyamidase hindering further metabolism of AP. For this, AP is theorized to cause less toxicity in humans. Our patient demonstrated significant cholinergic effects after a large volume ingestion requiring atropine, oxime therapy, and mechanical ventilation. Permanent inhibition ("aging") of MP-inhibited cholinesterase in humans is not well characterized and was not demonstrated in this case. A critical percentage of MP-inhibited cholinesterase enzyme may not have been permanently inactivated because pralidoxime was administered. Literature suggests that MP-inhibited cholinesterase is highly susceptible to reactivation by oximes.

Conclusions: Massive intentional ingestions of AP may produce severe effects in human exposure. Timely administration of pralidoxime may prevent prolonged toxicity.

KEYWORDS Acephate; methamidophos; organophosphate

brian.whitworth@childrensal.org

284. Bitis *Homo sapiens*: envenomation from a *Bitis rhinoceros* gaboon viper

Natasha Tobarran[a,b], Mona Ahmed[a], Andrew Chambers[a,b], Emily Kershner[a,b], Michelle Troendle[a,b], Rutherfoord Rose[a,b], Kirk Cumpston[a,b], Michael L'Heureux[a], Brittany Hardek[a], Spencer Greene[c] and Brandon Wills[a,b]

[a]Virginia Commonwealth University, Richmond, VA, USA; [b]Virginia Poison Center, Richmond, VA, USA; [c]HCA Houston Healthcare – Kingwood, Houston, TX, USA

Background: Exotic snake bites are uncommon in the US but can carry significant morbidity and mortality. Securing non-FDA approved antivenom (AV) from zoological parks is logistically complex, and often not available in a timely fashion. Appropriate supportive care is typically the foundation of management until definitive treatment with AV is available. We report a case of life-threatening envenomation from a captive Western Gaboon viper *(Bitis rhinoceros)* (GV) that resulted in rapid hematologic and soft tissue venom effects.

Case report: A 44-year-old male presented to our tertiary center emergency department immediately after sustaining a bite to the right hand by his captive GV while changing the water in the enclosure. As he reflexively withdrew, one fang made contact to the dorsum of his hand causing a 5-cm laceration, while the other fang created a puncture wound. Within an hour edema and ecchymosis were noted approximately 5 cm proximal to the wrist. The regional poison control center was contacted and quickly mobilized sixteen vials of South African Institute for Medical Research (SAIMR) equine whole IgG polyvalent snake antivenom from a regional zoo. Ninety minutes after envenomation spontaneous bleeding occurred from the laceration and laboratory studies revealed a platelet count of 5000/mm^3, prothrombin time of 43 seconds, INR of 4.5, and fibrinogen level of 88 mg/dL. Hemostasis was achieved with direct pressure and stapling of the wound. Four hours post envenomation, the patient became hypotensive (systolic in the 80s) which responded to crystalloids. The patient was admitted to the ICU and received 5 vials of antivenom 7 h post-envenomation. He developed a severe hypersensitivity reaction from the antivenom infusion treated with epinephrine, corticosteroids, H1/H2 antagonists and intubation. The patient received an additional 5 vials of antivenom based on coagulation studies and progression of soft tissue injury. The patient was weaned off vasopressors and extubated 16 h post envenomation. The local effects included edema, hemorrhagic bullae, and ecchymosis to the shoulder that subsequently improved with elevation and hand therapy (OT/PT). The patient was discharged on hospital day nine with no recurrence of hematologic toxicity or serum sickness. Two weeks post envenomation the arm remained purpuric with improved hand function, though he was treated with amoxicillin/clavulanate for cellulitis at the bite site.

Discussion: Gaboon viper envenomation can result in severe local tissue necrosis and venom induced consumptive coagulopathy. These vipers produce the largest amount of venom of all snakes in the world and bites are rare as they are usually non-aggressive. The treatment of choice is prompt administration of antivenom, usually complicated by its lack of availability.

Conclusions: Management of non-indigenous envenomations in the US presents with many challenges. Due to the severity of Gaboon viper envenomation prompt administration of antivenom is important to attenuate morbidity and mortality. Regional poison centers are a valuable resource in identifying and obtaining non-native snake antivenom in a timely manner.

KEYWORDS Western gaboon viper; envenomation; antivenom

natasha.tobarran@vcuhealth.org

285. Thai green pit viper antivenom to treat *Trimeresurus insularis* envenomation

Madeline Kenzie[a], Justin Corcoran[a], Ryan Feldman[b], Matt Stanton[c], David Gummin[d] and Jillian Theobald[a]

[a]Medical College of Wisconsin, Milwaukee, WI, USA; [b]Froedtert and The Medical College of Wisconsin, Milwaukee, WI, USA; [c]Froedtert and the Medical College of Wisconsin, Brookfield, WI, USA; [d]Medical College of Wisconsin-Emergency Medicine, Milwaukee, WI, USA

Background: *Trimeresurus insularis*, commonly known as the blue pit viper, is indigenous to Indonesia. This alluring snake injects fibrinogenases and hemorrhagins that cause potentially lethal coagulopathy and extensive bleeding. Other symptoms may include local pain, swelling, blistering, and necrosis. There is

no specific antivenom for *T. insularis* envenomation. In vitro studies and a murine model suggest that Thai green pit viper antivenom (TGPAV, also abbreviated GPVAV), an $F(ab')_2$ fragment antibody, might be effective against *T. insularis* human envenomations. Available reports demonstrate that antivenom raised to *T. albolabris*, commonly known as the Thai green pit viper, was effective against some other *Trimeresurus* species, though *T. insularis* was not among them.
Case report: A 45-year-old male with hypertension presented to an emergency department 30 min after sustaining fang punctures by *T. insularis* in his dorsal right index and middle finger. On initial evaluation the patient was complaining of local pain and had edema in the involved digits and distal radial right hand, without ecchymosis. There was no evidence of coagulopathy on lab assessment. He was transferred to a tertiary receiving hospital approximately 4 h after envenomation with an unchanged physical exam and unchanged coagulation markers. Through the Antivenom Index, TGPAV manufactured by the Queen Saovabha Memorial Institute in Bangkok, Thailand was located at a zoo 300 miles away. Antivenom was emergently transferred by courier to the receiving hospital. The patient developed worsening edema extending to his forearm, as well as ecchymosis of his envenomated fingers over the first 12 h. D-dimer increased from 0.47 to 0.86 mg/L (normal <0.69 mg/L). At this time, the patient was premedicated with diphenhydramine, famotidine, and methylprednisolone after which two vials of TGPAV were given. The patient was re-dosed with two vials each at hour 18 and hour 24 post envenomation due to increased pain, edema, and increasing D-dimer. The patient's edema improved and pain resolved. Although the D-dimer remained elevated, fibrinogen, PT and PTT were not affected. There was no clinical evidence of coagulopathy. While hospitalized the patient received hydrocortisone 50 mg every 6 h with plans to continue for 2 weeks after discharge to prevent serum sickness. Patient was discharged approximately 72 h after envenomation with improved local symptoms and stable coagulation markers. There was no evidence of hypersensitivity or other adverse reaction during treatment or at follow-up 6 days post-envenomation.
Discussion: This case highlights potential clinical benefit by utilizing TGPAV for *T. insularis* envenomation given clear improvement in symptoms and clinical findings. Our patient tolerated TGPAV without untoward reactions.
Conclusions: In managing *T. insularis* envenomation, it's important to be aware of the potential safety, efficacy, and relative availability of TGPAV, despite lack of FDA approval. The use of TGPAV for envenomation by other species requires further clinical research.

KEYWORDS Pit viper; envenomation; antivenom

mkenzie@mcw.edu

286. Pain pump predicament

Jamie Hutchins and Nikki Ritchie

Alabama Poison Information Center, Birmingham, AL, USA

Background: The goal of this case report is to describe flaccid paralysis following intrathecal bupivacaine manipulation that was treated with intravenous lipid emulsion (ILE) therapy. Many case reports have explored the successful use of ILE therapy to reverse intravenous local anesthetic toxicity that can present with neurologic complications with or without the presence of cardiac toxicity. In this case, we address the outcome in the use of ILE for intrathecal bupivacaine toxicity.
Case report: A 68-year-old male with a history of vertebral injury and hypertension required an intrathecal pump for pain management. His device holds a 70-day supply of medication. Medications included clonidine 70 mcg/mL, morphine 3.5 mg/mL, and bupivacaine 2.75 mg/mL. The patient was having medications refilled via pump by a home health care company in a grocery store parking lot when an error occurred during the administration of medications triggering an immediate loss of sensation from his abdomen into his lower extremities. He presented to the closest emergency department within 45 min alert and oriented. Vitals were notable for mild hypotension and bradycardia to 40 beats per minute. Over the next several hours he also became mildly lethargic. Initial labs on arrival demonstrated hypokalemia of 2.2 mEq/L that was soon corrected. Patient was given naloxone to treat potential clonidine and morphine exposure and bolused ILE as antidote for systemic toxicity of intrathecal bupivacaine. Patient was transferred to a tertiary hospital for inpatient stay and approximately 9 h following ILE therapy, he regained sensation in his abdomen and legs but remained bradycardic. 24 h post ILE therapy, patients vitals were back to baseline and he was cleared 3 days post admission with full resolution of symptoms.
Discussion: Review of literature reveals a previous case report of intrathecal bupivacaine/morphine pump malfunction during refill resulting in lower extremity sensory neuropathy followed by obtundation, hypotension, and lower extremity flaccidity. Her condition evolved to status epilepticus refractory to standard treatment. ILE was administered but was not immediately effective; she was subsequently treated with a phenobarbital bolus and a propofol infusion. In our specific case, neurotoxicity with mild cardiotoxicity was identified early and ILE therapy was started promptly but patient had effects lasting up to 24 h. Both cases are notable for absence of an immediate temporal improvement with ILE but eventual resolution of neurotoxic effects.
Conclusions: Intrathecal bupivacaine toxicity may present with spinal paralysis; optimum treatment remains ambiguous and further study into management may be warranted.

KEYWORDS Lipid emulsion; bupivacaine; paralysis

Jamie.Bergeron@childrensal.org

287. Two-year analysis of national poison data system fatalities attributed to methamphetamine

Chidiebube Nzeako[a], Keith Burkhart[b] and Christina Hantsch Bardsley[a]

[a]US Food and Drug Administration, Silver Spring, MD, USA; [b]US Food and Drug Administration, Hershey, PA, USA

Background: Fatalities related to methamphetamine overdose have markedly increased as the fourth wave of the opioid epidemic often includes concomitant stimulants. Evaluating the patterns, trends, and treatment regimens used for methamphetamine overdose may provide insights into reducing the mortality.
Methods: Fatality abstracts from 2018 and 2019 were obtained from the National Poison Data System (NPDS) where methamphetamine overdose was coded as (1) undoubtedly responsible or (2) probably responsible as the cause of death. Each abstract was reviewed by two physicians including a medical toxicologist, to extract demographic data, route of exposure, concomitant exposure, clinical presentation, and treatments. Descriptive analysis was completed for each year and the results of the 2 years were compared.
Results: Fifty-nine cases met inclusion criteria for each year. Men accounted for 80% of the fatality reports with most fatalities occurring in the age group between 18 and 39 years old. Fifteen cases in 2018 and nine cases in 2019 were associated with ingestions during an impending law enforcement encounter.

Approximately half of the cases in 2018 and 2019 were single substance methamphetamine overdose. In polysubstance cases, opioids, other stimulants, cannabinoids, benzodiazepines, and alcohols were the most reported concomitant exposures. The recommended maximum daily dose for methamphetamine is 60 mg; for cases with reported dosages, the dosage range was 1–17 g. Reported postmortem serum methamphetamine concentrations ranged from 0.02 mg/L to 17.75 mg/L and 0.01 mg/L – 6.8 mg/L for antemortem serum concentrations (reference range: 0.02–0.05 mg/L). The most common emergency department presentations were post cardiac arrest, agitated delirium with hyperthermia, hyperthermia without agitated delirium, and agitated delirium without hyperthermia. The most reported therapeutics were benzodiazepines, naloxone, propofol, fentanyl, and antipsychotics.

Conclusions: A review of the NPDS 2018 and 2019 methamphetamine fatality abstracts of patients who arrive at the hospital revealed that men between 18 and 39 years old accounted for most cases. Many cases involved ingestions of large quantities of methamphetamine. Agitated delirium usually with hyperthermia and post cardiac arrest were the most common presentations. Further research evaluating recent methamphetamine fatalities and serious nonfatal cases is needed to identify effective new treatment approaches.

KEYWORDS Methamphetamine; National Poison Data System (NPDS); fatality

chidiebube.nzeako@gmail.com

288. Utilizing machine learning to predict coagulopathy in acetaminophen toxicity

Nikolaus Matsler[a], Sasha Kaiser[a], Stephen Cook[b], HoanVu Nguyen[a] and Christopher Hoyte[a]

[a]Rocky Mountain Poison and Drug Safety, Denver, CO, USA; [b]Research Fellow, Department of Biology, University of Oklahoma, Norman, OK, USA

Background: Acetaminophen (APAP) is a common ingestion and the leading cause of fulminant liver failure in the US. Currently, transplant criteria such as King's College Criteria (KCC) are utilized following clinical deterioration to determine appropriateness for transfer to transplant centers. Our objective was to determine whether machine learning (ML) techniques can prognosticate which patients may require a higher level of care based on initial aminotransferase, APAP concentration, and international normalized ratio (INR) trends.

Methods: We trained a Deep Learning Neural Network (DNN) to predict which patients would develop an INR $\geq$6.5. Data for training was obtained from the CAOS, US NMS, and IV NAC studies. Inclusion criteria consisted of patients with acetaminophen exposure, a minimum of two aminotransferase and acetaminophen concentrations, and two INRs. Patients were further categorized into binary classes based on presence/absence of severe coagulopathy as defined by an INR $\geq$6.5. The outcome of interest, an INR $\geq$6.5, was a rare event and thus Synthetic Minority Oversampling-Technique (SMOTE) with K-nearest neighbor (KNN) was utilized to balance these groups prior to model training. The resulting dataset was subsequently used to train and validate a fully connected DNN while varying layer size and depth to yield the greatest accuracy. We validated the DNN performance using K-fold cross validation. For each fold, we calculated the percentage of patients for which the DNN correctly predicted INR status. Finally, to simulate a real-world use-case, we used the DNN to predict INR status of patients in an independent dataset, built from APAP poisonings requiring acetylcysteine over the last 5 years from an urban, county hospital.

Results: The composite training dataset comprised 12,106 patients, of which 4254 met inclusion criteria. Of these, 74 developed an INR $\geq$6.5. SMOTE with a KNN of 4 remedied the class-imbalance prior to training and produced 4145 patients with INR $\geq$6.5 and 4180 with INR $<$6.5. A DNN was then trained and validated. DNN cross-validation indicated that the model performed with a 98.7% mean accuracy among K-folds. The independent dataset we used for additional retrospective validation contained 489 total patients, 7 of which had an INR $\geq$6.5, however 5 of these patients met INR criteria of $\geq$6.5 upon arrival. The DNN correctly predicted 7/7 of these cases.

Conclusions: Machine learning techniques are being adopted increasingly in medicine. However, application to clinical toxicology is currently lacking. We present a novel DNN trained to accurately predict patients that will develop severe coagulopathy during their hospitalization. With this clinical tool, clinicians may be able to make decisions at an earlier time, utilizing commonly available labs, prior to medical decompensation. Future research should focus on prospective validation prior to widespread adoption.

KEYWORDS Machine learning; acetaminophen (APAP); deep neural networks

nik.matsler@denverem.org

289. Toxic encephalopathy from intrathecal amphotericin B deoxycholate overdose treated with cerebral spinal fluid exchange

Garret Winkler[a], Nate Friedman[a], Justin Seltzer[a], Michael Doud[b], Sanjay Mehta[b], Richard Clark[a] and Charles O'Connell[a]

[a]Division of Medical Toxicology, University of California San Diego, San Diego, CA, USA; [b]Division of Infectious Diseases and Global Public Health, University of California San Diego, San Diego, CA, USA

Background: Intrathecal (IT) amphotericin B deoxycholate (AmBd) has been used since the 1950s for the treatment of fungal meningitis from *Coccidioides* spp., but first-line use has been largely supplanted by oral azoles. Common adverse events with therapeutic dosing include headaches, nausea, vomiting, neurotoxicity, arachnoiditis, and chemical meningitis. Use of IT corticosteroids may reduce inflammation, headaches, and pleocytosis. There is limited experience with overdose of IT AmBd. One published case report exists which detailed acute toxic encephalopathy and EEG abnormalities that resolved after medication discontinuation.

Case report: This is a single-patient chart review. A 42-year-old man with coccidioidal meningitis receiving monthly IT AmBd via ventricular Ommaya reservoir presented to the emergency department from clinic with severe headache and diffuse body pain following routine AmBd and hydrocortisone 20mg IT infusion. He initially tolerated the procedure well but developed severe, acute onset headache, vomiting, diffuse body pain, ascending paresthesias, and somnolence when sitting up after 2 h. Vital signs were heart rate 78 beats/min, blood pressure 150/98 mmHg, respirations 22/min. It was discovered that he was incorrectly administered 8 mg amphotericin B deoxycholate instead of 0.8 mg due to a pharmacy preparation error. CT head was notable for increased ventricular size compared to baseline and the patient was administered 100 mg methylprednisolone IV. The patient developed progressive somnolence, altered mental status, and extremity weakness over 7 h. He was kept in a recumbent position until 8 h after medication administration the

Ommaya reservoir was accessed, 30 mL cerebral spinal fluid (CSF) was removed, and 20 mL of 0.9% sodium chloride solution was instilled. On hospital day 2 the patient's headache, diffuse body pain, spasticity, paresthesias improved. The patient was discharged on hospital day 4 with baseline neurologic exam and near resolution of symptoms.
Discussion: Our patient developed encephalopathy like other toxic IT overdoses. There is limited published experience with IT AmBd overdose and patients can experience significant toxicity with routine therapeutic administration. Due to the lack of published experience this overdose was treated as a potentially life-threatening exposure. Ommaya reservoir CSF exchange was initially attempted to limit further drug exposure. AmBd is highly lipophilic, which may have limited the effectiveness of CSF exchange relative to better established indications such as IT doxorubicin or methotrexate overdoses, which both have low lipophilicity. It is possible that a majority of AmBd had already peripherally distributed after 8 h and thus CSF exchange was not repeated. The patient was also administered parental corticosteroids to treat inflammation. It is unclear if the CSF exchange and/or corticosteroids limited toxicity or hastened recovery; it is possible that we simply observed the natural course of toxicity.
Conclusions: Intrathecal amphotericin B deoxycholate overdoses remains a rare and scantly reported toxicity. Toxic encephalopathy may result after overdose. Until further research is performed it is reasonable to pursue CSF exchange to limit drug absorption and to administer parenteral corticosteroids.

KEYWORDS Intrathecal; amphotericin; encephalopathy

gwink3@gmail.com

290. National estimates of antidepressant-related poison center calls

Saumitra Rege, Will Goodrich and Christopher Holstege
University of Virginia, Charlottesville, VA, USA

Background: Approximately 92,000 persons in the US died from drug-involved overdose in 2020. Estimated rates of depressive and anxiety symptoms among adults have increased in recent years. According to a recent study, more than 20 million antidepressants were prescribed between October and December 2020. The objective of our study was to evaluate the trends in antidepressant-related calls to the US poison centers (PCs).
Methods: The National Poison Data System (NPDS) was queried for all closed, human exposures to antidepressants from January 01, 2015 through December 31, 2021 using the American Association of Poison Control Center (AAPCC) generic code identifiers. We identified and descriptively assessed the relevant demographic and clinical characteristics. Reports from acute care hospitals and hospital based EDs (ACHs) were evaluated as a subset. Trends in antidepressant frequencies and rates (per 100,000 human exposures) were analyzed using Poisson regression methods. Percent changes from the first year of the study (2014) were reported with the corresponding 95% confidence intervals (95% CI).
Results: During the study period, there were 836,045 toxic exposures to antidepressants that were reported to the PCs. The frequency of exposures increased by 20.3% (95% CI: 16.1%, 23.9%; $p < 0.001$), and the rate of exposures decreased by 22.3% (95% CI: 17.8%, 25.9%; $p < 0.001$). Of the total antidepressant calls, the proportion of calls from ACHs decreased from 38.3% to 34.8%, while the percentage of calls from the general public increased. Multiple substance exposures accounted for 52.4% of the overall antidepressant calls and 56% of calls from ACHs. Approximately 18% of the patients with reported antidepressant exposures were admitted to a critical care unit (CCU), with 17% of patients admitted to a psychiatric facility. Residence was the most common site of exposure (93.8%), and 67% of these cases were enroute to the hospital via EMS when the PC was notified. Cases were predominantly female (65.3%), with the most common age group being 20–29 years (14.9%). The proportion of such cases (28.7–34.1%) increased during the study period. Suspected suicides (57.2%) were the most common reason for exposure, with the proportions of suspected suicides being higher in cases reported by ACH (12.1% vs 14.9%). During the study period, the proportion of reported antidepressant exposures due to therapeutic errors increased (18.5–22.3%), while suspected suicides decreased (58.6–54.2%). Major effects were seen in 8.2% cases and case fatality rate was 0.3%, with 169 fatalities reported for single substance antidepressant exposures. The most frequently co-occurring substances associated with the cases were alcohol (12%) and marijuana (9.7%). Tachycardia (42.8%) and agitation (35.5%) were commonly observed clinical effects.
Conclusions: Our study results demonstrate a significant increase in the reports of antidepressant exposures made to the PCs. Exposures in young age groups were common and the most frequent reason for exposure were suspected suicides. Continued surveillance and public health prevention efforts are key to track the population effects of antidepressant exposures.

KEYWORDS Antidepressant; National Poison Data System; overdose

svr5d@hscmail.mcc.virginia.edu

291. Don't let metformin toxicity fall into the knowledge gap: a case series of patients with elevated osmolar gap in the setting of metformin toxicity

Carin Malley, William Trautman, Alek Adkins, Matthew Scanlon, Anthony Pizon and Joseph Yanta
University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Background: Osmolar gap is a commonly employed screening tool for toxic alcohol ingestion largely due to the relative scarcity of gas chromatography needed to measure quantitative serum levels of methanol and ethylene glycol. The positive and negative predictive values of serum osmol gap for toxic alcohols are poor, especially when a value of 10 mOsm/L is used as the upper limit of normal. However, many non-toxicologists do not appreciate the diagnostic limitations and broad differential that remains after an elevated osmolar gap is identified. This can lead to mismanagement of patients. In this case series we present three cases with osmolar gap >30 mOsm/L in the setting of metformin associated metabolic acidosis (MAMA) and in the absence of toxic alcohol exposure.
Case series: We present a series of three patients evaluated at a tertiary care center with MAMA and osmolar gaps >30 mOsm/L in the absence of toxic alcohol exposure. Diagnosis of MAMA was made by board certified medical toxicologists based on presentation with severe metabolic acidosis, lactate elevation, and metformin exposure with factors that would decrease metformin elimination. In cases #1 and #3, diagnosis was confirmed with quantitative serum metformin levels of 38 mcg/mL and 470 mcg/mL, respectively. Metformin level was not available in case #2. All three patients had a pH <6.9 and lactate >15 mMol/L. In cases #1 and #2, the mechanism of metformin accumulation was continued therapeutic metformin doses in the setting of severe acute kidney injury (AKI) with presenting creatinine of 11 and 15.32 mg/dL, respectively. In case #3, the patient presented soon after an acute ingestion of 90 gm of metformin and 60 tablets of

acetaminophen-diphenhydramine combination product. By the time case #3 was transferred to the tertiary care center 3 h later, she was anuric. Osmolar gap was calculated using the standard equation [(2 × Na) + (BUN/2.8) + glucose/18)]. Ethanol was negative in all three cases. Osmolar gap was calculated at 39.8, 46, and 34.8 mOsm/kg for patients #1, #2, and #3, respectively. Methanol, ethylene glycol, and isopropyl alcohol were ruled out by serum gas chromatography for patients #1 and #2 and by history and collateral information in patient #3. All three were treated with continuous hemodialysis (HD) for 10.75 h, 13 h, and 47.75 h respectively until serum lactate levels were <3 mMol/L in accordance with EXTRIP guidelines.
Discussion: While previous literature has documented that a lactate elevation is associated with an elevated osmolar gap of approximately 10.3 mmol/kg, there has only been one other reported case of elevated osmolar gap in the setting of MAMA. That previous case documented an osmolar gap of 20 mOsm/kg. Our series is the first to document multiple confirmed cases of MAMA with a serum osmolar gap >30 mOsm/kg.
Conclusions: Patients with MAMA can develop an osmolar gap of >30 mOsm/kg. MAMA is a life threatening and treatable condition that should be a part of the complete differential diagnosis of the critically ill patient with an elevated osmolar gap, profound acidosis and elevated lactate.

KEYWORDS Osmolar gap; metformin; metabolic acidosis

malleyck@upmc.edu

292. Breaking the heart and breaking the blood: a case series of cutaneous-hemolytic loxoscelism with cardiac involvement

Rebecca Bruccoleri[a], Samuel Littlejohn[b], Christopher Henderson[b], Jeffrey Weiner[b], Adam Skaff[b] and Saralyn Williams[b]

[a]Tennessee Poison Center, Nashville, TN, USA; [b]Vanderbilt Children's Hospital, Nashville, TN, USA

Background: Brown recluse envenomations may range from localized necrotic skin lesions to systemic illness with serious complications including rapid hemolysis, rhabdomyolysis, and disseminated intravascular coagulation. Myocarditis has rarely been reported.
Case series: Case 1: 12 y/o girl presented to the ED with 2 days of fever, malaise, sore throat, and rash on the left arm after a stay at an outdoor summer camp where loxosceles reclusa are endemic. She was tachycardic and febrile, with a 1-cm black bulla on her proximal left arm with surrounding erythema to distal arm. Her HCT was 41.1% and she was admitted for treatment of cellulitis and concern for sepsis or toxic shock syndrome. On hospital day (HD) 5, transthoracic echo (TTE) showed hyperdynamic wall motion. She was transferred to a referral hospital on HD 6 where she was afebrile but tachycardic and tachypneic. Physical exam showed diffuse erythroderma and pustulosis with a 2 cm ×3 cm black eschar at the site of the previously noted bulla. Her CRP was 149.4 mg/L, ESR >145 mm/h, Hct 13%, troponin-I 0.20 ng/mL (normal <0.03), BNP 856 pg/mL (normal <100), lactate 12 mmol/L (normal 0.5–2.02 mmol/L). ECG showed sinus tachycardia. She was given 1 unit pRBCs and admitted for cutaneous-hemolytic loxoscelism. On HD 7, she developed respiratory failure requiring intubation. Subsequent TTE showed mild-to-moderately depressed LV function and mildly depressed RV function. Troponin peaked at 0.83 ng/mL. TTE 2 days later showed normal wall motion. She was extubated after 5 days. She required a total of 7u pRBCs. She was discharged on HD 15 and followed in toxicology clinic. Her wound exhibited good healing until she was lost to follow-up ~2 months after discharge. Case 2: 15 y/o girl presented with a ~2 cm ×1.5 cm necrotic lesion to her right medial calf with surrounding induration and erythema. She first noticed the lesion 5 days prior to admission and rash on her arms the following day. Review of relevant systems was otherwise negative. Exam revealed tachycardia, no conjunctival pallor, the lesion noted above, and a blanching, macular rash to arms, abdomen, and legs, suggestive of systemic loxoscelism. Initial HCT was 35% and CRP was 87.9 mg/L. She was admitted for serial HCT and UA monitoring. Overnight between HD 1 and 2, she developed vomiting, and the following morning, substernal chest pain with burning. Her ECG showed 0.5–1 mm ST elevation in V4-V6 diagnosed as early repolarization. Her troponin was 3.52 ng/mL which peaked at 3.83 ng/mL and normalized after 5 days. TTE was normal for age. Her HCT fell to 26 on HD 2 and to 21 on HD 3, she received 2 units of pRBCs. Repeat HCT was 33 and no further pRBCs required. She was discharged on HD 6 and followed in toxicology clinic. In outpatient cardiology clinic, there was concern that patient had myocarditis, but she did not require follow up, given resolution of symptoms and normal troponin. An ECG ~2 months later was normal without ST elevation.
Discussion: There are rare reports of myocarditis associated with loxosceles envenomations. A murine model has demonstrated binding and injury of the myocardium from *Loxosceles intermedia* venom. Previous reports of rhabdomyolysis did not always exclude myocardial injury as the cause of the elevated creatine kinase.
Conclusions: These two cases demonstrate the possibility of myocardial involvement with acute loxoscelism and illustrate the need for vigilance in caring for these patients.

KEYWORDS Brown recluse; myocarditis; hemolysis

Rebecca.e.Bruccoleri@vumc.org

293. Incidence of acute hypersensitivity reactions to currently available crotaline antivenoms in pediatric patients

Elizabeth Grossart[a], Gabriella Gambadoro[b], Geoffrey Smelski[c] and Farshad Mazda Shirazi[c]

[a]Department of Emergency Medicine, University of Arizona, Tucson, AZ, USA; [b]Banner University Medical Center – Tucson, Tucson, AZ, USA; [c]Arizona Poison and Drug Information Center, Tucson, AZ, USA

Background: Rattlesnake envenomations in our region are routinely treated with antivenom. Fab and $F(ab')_2$ antivenoms (AV), with no Fc portion, lower protein content, and more efficient purification, have been shown to elicit fewer hypersensitivity reactions than whole IgG antivenom. Acute hypersensitivity reactions to antivenom are generally not life-threatening but may affect the rate or amount of antivenom administered. Previous studies of pediatric patients aged 0–13 identified only one acute hypersensitivity reaction to Fab antivenom. We analyzed 197 pediatric rattlesnake envenomations who received Fab AV or $F(ab')_2$ AV to determine incidence and characteristics of acute hypersensitivity reactions to currently available crotaline antivenoms.
Methods: This is a retrospective chart review of patients aged 0–13 years diagnosed with rattlesnake envenomation and treated with Fab AV or $F(ab')_2$ AV between January 2001 and December 2020. Specifically, we sought to identify children who developed acute hypersensitivity reactions after infusion of AV. To compare

our data with a previous study, we defined acute hypersensitivity reaction as any of the following symptoms: urticaria, wheezing or respiratory distress, angioedema, hypotension, nausea, and/or vomiting occurring within 3 h of antivenom infusion. Demographic parameters, bite site, antivenom type, time to antivenom, acute hypersensitivity reaction symptoms, treatments, total number of vials of antivenom administered, and presence of delayed coagulopathy were recorded.
Results: A total of 197 patients were treated with Fab AV or $F(ab')_2$ AV for rattlesnake envenomation during the 20-year study period. Six (0.3%) children had symptoms consistent with acute hypersensitivity reaction. Children who had acute hypersensitivity reactions had an average age of 5.2 years with a range of 3–9 years. Three patients were male. Five patients sustained lower limb bites. One patient received both Fab AV and $F(ab')_2$ AV. Average time to antivenom was 110 min with a median of 97 min. Average total vials administered in children with acute hypersensitivity reactions was 18.5; median was 17.5. Urticaria, wheezing or respiratory distress, angioedema, and nausea/vomiting each occurred in two patients. Acute hypersensitivity reactions were treated by slowing the infusion rate in two patients. One patient who received both antivenoms required epinephrine, diphenhydramine, famotidine, and methylprednisolone after Fab AV but not $F(ab')_2$ AV. One patient each received ondansetron and albuterol. Three patients had delayed coagulopathy.
Conclusions: Acute hypersensitivity reactions to currently available crotaline antivenoms occurred in 0.3% of our population. We did not see any acute hypersensitivity reactions in our limited population of patients aged 0–13 years who received $F(ab')_2$ AV exclusively ($n = 18$). Acute hypersensitivity reactions do not appear to decrease the total number of vials used to treat envenomation compared with the previous study. Delayed coagulopathy may have an association with acute hypersensitivity reactions but no conclusion can be made from these data.

KEYWORDS Hypersensitivity; pediatric; antivenom

elizabeth.grossart@gmail.com

294. Successful treatment of pediatric CCB overdoses with HDI at 10 U/kg/h and beyond

Taylor Sanders, Ann-Jeannette Geib, Wyn Wheeler, Nicholena Richardson and Christine Murphy

Atrium Health's Carolinas Medical Center, Charlotte, NC, USA

Background: Calcium-channel blocker (CCB) overdose can result in distributive and cardiogenic shock. High dose insulin (HDI) is a key component of inotropic support in such cases, and Cole et al demonstrated safety with doses of 10 U/kg/h and higher. Although Sallam et al reported treatment with HDI at 9 U/kg/h for 7 days in a 15-year-old, there remains minimal literature demonstrating safety and efficacy in pediatrics. We present two cases of successful management of CCB overdose in children using HDI doses of 10 U/kg/h and greater, concentrated to 16 U/mL.
Case series: A 12-year-old was transferred 9 h after ingesting an unknown amount of amlodipine. They arrived intubated, having already received standard therapies. HDI at 8 U/kg/h and 1 mcg/kg/min of both norepinephrine (NE) and epinephrine (EPI) were actively infusing. Their initial blood pressure (BP) at our facility was 70/40 with echocardiogram (ECHO) showing decreased ejection fraction. HDI was titrated to 20 U/kg/h, increasing their BP to 114/68. Oliguric with developing volume overload, they required continuous renal replacement therapy (CRRT) and venovenous extracorporeal membrane oxygenation (VV-ECMO). Attempts were made to decrease volume throughout their course by weaning insulin, however hemodynamics positively correlated with HDI at 10 U/kg/h and higher. On HD10, after discontinuing vasopressors, HDI was titrated off. Supplemental dextrose was needed for an additional 48 h. CRRT and VV-ECMO were discontinued by HD 13, followed by extubation on HD17, and transfer to the floor on HD20. A 15-year-old ingested 12 verapamil 120mg ER 7 h before presenting to an outside facility with BP 92/31 and pulse 49. He received a fluid bolus, calcium, NE, EPI, 1 unit/kg insulin bolus, and HDI at 1 unit/kg/h. On arrival, his BP was 87/28 with pulse 50. He was intubated and HDI titrated to 20 units/kg/h with improved hemodynamics. ECHO at 12 h, while on HDI, showed normal contractility. NE and EPI were discontinued at 58 and 74 h. HDI was then weaned and stopped after 91 h. Supplemental dextrose was required until HD8. HDI was concentrated to 16 U/mL in both cases. There were no dosing errors observed and appropriate effects were seen as doses were adjusted, suggesting stability and efficacy at this concentration. Both patients were discharged at their neurologic baselines with normal ECHOs.
Discussion: HDI was associated with improved hemodynamics compared to vasopressors in these cases. Despite up to 10 days of HDI and doses up to 20 U/kg/h, hypoglycemia was treated for 2–4 days after HDI discontinuation. To our knowledge, these cases represent the greatest reported duration and dose of HDI in the pediatric age group. Laskey et al demonstrated stability of HDI concentrated to 16 U/mL, and this proved safe in these cases.
Conclusions: HDI is safe and effective for CCB-induced cardiogenic shock in pediatrics, even for extended periods and doses up to 20 U/kg/h. Minimizing volume is essential and concentrating insulin to at least 16 U/mL is safe. Future research should be done to evaluate the safety of more highly concentrated insulin infusions, as well as to compare outcomes based on total volume administered.

KEYWORDS High dose insulin; calcium channel blocker; pediatric

taylor.sanders@atriumhealth.org

295. Huffing as an anaphylaxis mimic: a cautionary tale of difluoroethane toxicity

William Trautman, Alek Adkins, Carin Malley, Matthew Scanlon, Anthony Pizon and Michael Abesamis

University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Background: Patients with difluoroethane toxicity are at risk for cardiac dysrhythmia from myocardial sensitization and potassium channel blockade, as well as defatting dermatitis and cryogenic burn injuries. This constellation of symptoms is an uncommon presentation to the emergency department and could be mistaken for anaphylaxis or angioedema.
Case report: A 22-year-old female was found unresponsive in a retail store bathroom with two empty bottles of unknown liquid and a nearly empty bottle of acetaminophen-diphenhydramine pills. She had swelling of the right hand and significant lip swelling. Due to concerns for anaphylaxis, she was treated with 125 mg intravenous methylprednisolone and 0.3 mg intramuscular epinephrine pre-hospital. In the ED she had blistering lesions on her right hand, and significant swelling and blistering of the lips. ENT was consulted for concern for angioedema and performed a laryngoscopy in the ED showing no edema in the larynx or oropharynx. She exhibited mumbled speech, mydriasis, tachycardia, carphologia and urinary retention consistent with antimuscarinic toxicity. Her work up was significant for an acetaminophen level of 421 mcg/mL, potassium level of 2.9 mMol/L, pH of 7.3, anion gap of 22 with a bicarbonate level of 14 mMol/

L, and undetectable ethanol and salicylate levels. Her initial EKG revealed a sinus rhythm with a rate of 141 bpm, QRS duration of 78 ms, and QTc of 557 ms. She was treated with fluid resuscitation, n-acetylcysteine, fomepizole, potassium supplementation and admitted to the ICU. Her sensorium cleared, and she admitted to huffing computer duster containing difluoroethane. She did not develop acetaminophen-induced liver injury, and her repeat EKG 36 h later showed an improving QTc to 485 ms. She was safely discharged home after plastic surgery evaluation of her wounds, and psychiatry evaluation.

Discussion: This patient presented as a polysubstance overdose, and was unable to provide meaningful history. She had signs of huffing-related hydrocarbon burns with blistering periorally and to her right hand. Additionally, she was at risk for cardiac dysrhythmia, with increased risk in the setting of a catecholamine surge. She was misidentified as suffering from anaphylaxis prehospital and administered epinephrine. Fortunately, she did not suffer adverse treatment effects such as arrhythmia and a "sudden sniffing" cardiac death. However, this highlights the need for awareness of halogenated hydrocarbon toxicity presentation and its potentially catastrophic consequences.

Conclusions: Halogenated hydrocarbon cryogenic burns can mimic anaphylaxis and angioedema. Mechanistically, treatment for anaphylaxis with catecholamines may worsen the cardiotoxicity of halogenated hydrocarbon exposure. Given the potential for life threatening cardiotoxicity, recognition of this presentation is critical.

KEYWORDS Huffing; halogenated hydrocarbon; burn

trautmanwj@upmc.edu

296. Oropharyngeal, esophageal, and renal injury from combined glyphosate and diquat ingestion

James Whitledge[a], Christopher Watson[b], Michael Simpson[c], Leonie Oostrom-Shah[d] and Katherine Boyle[e]

[a]Boston Children's Hospital, Harvard Medical Toxicology Fellowship, Boston, MA, USA; [b]Boston Children's Hospital, Boston, MA, USA; [c]Boston Children's Hospital, Brookline, MA, USA; [d]Beth Israel Deaconess Medical Center, Boston, MA, USA; [e]Beth Israel Deaconess Medical Center, Harvard Medical Toxicology Fellowship, Boston, MA, USA

Background: Glyphosate and diquat are commonly used herbicides that may result in significant acute toxicity. Glyphosate and the polyethoxylated tallow amine (POEA) surfactants it is co-formulated with may cause caustic gastrointestinal (GI) tract and airway damage, as well as injury to multiple organs including the kidneys and liver. Diquat causes similar injuries. Significant harm reported with these agents typically involves high concentration formulations. Combined glyphosate and diquat ingestions are rarely reported. We present a case that uniquely highlights the combined toxicity of these agents despite low individual agent concentrations.

Case report: A 33-year-old man presented to the emergency department 1 h after drinking six sips of Roundup Concentrate Plus, which contains 18% glyphosate isopropylamine and 0.73% diquat dibromide, in a self-harm attempt. He complained of sore throat but had no evidence of oropharyngeal injury on exam therefore intubation was deferred. Initial creatinine and transaminases were normal. The patient was admitted to the intensive care unit. Aspartate transaminase (AST) and alanine transaminase (ALT) increased to 272 IU/L and 138 IU/L, respectively, and intravenous n-acetylcysteine was initiated with subsequent normalization of AST and ALT. Creatinine increased from 1.0 to 5.3 mg/dL within 24 h and the patient became anuric. Intermittent hemodialysis was initiated for anuric renal failure and potential residual toxin clearance. On hospital day 2 he was intubated for endoscopy. Intubation was complicated by severe upper airway caustic injury; seven intubation attempts by three attending anesthesiologists were required. Endoscopy showed Zargar class IIA injury to proximal and mid-esophagus and Zargar class IIB injury to the distal esophagus. The patient received 3 days of high-dose methylprednisolone, ceftriaxone, and pantoprazole for the Zargar IIB lesions. Follow-up barium swallow on hospital day 22 showed no strictures. Renal function improved and hemodialysis was discontinued on hospital day 26. The patient was discharged on hospital day 36. At 3-month follow-up, he had no dysphagia and creatinine was 1.3 mg/dL.

Discussion: Diquat and glyphosate cause caustic injury and multi-organ injury including nephrotoxicity and hepatotoxicity. Reports of significant toxicity usually involve single-agent high concentration formulations: 36–41% glyphosate or 20% diquat. One published case of combined diquat and glyphosate toxicity involved 100 mL of 20% diquat and 400 mL of 41% glyphosate and resulted in multi-organ dysfunction and acute respiratory distress syndrome. Our patient was exposed to approximately 150 mL of herbicide containing glyphosate and diquat in much lower concentrations, 18% and 0.73% respectively, yet sustained severe injury to the airway and GI tract and nephrotoxicity. Given the severity of his symptoms, the toxicities of these agents may be additive. He was treated with high-dose methylprednisolone for Zargar IIB esophageal lesions and did not develop strictures.

Conclusions: Diquat and glyphosate caustic and nephrotoxic effects may be additive such that low-concentration formulations of these agents, when combined, result in greater injury. Stricture formation after Zargar IIB caustic injury from diquat and glyphosate may be prevented by high-dose steroids.

KEYWORDS Diquat; glyphosate; caustic and renal injury

james.whitledge@childrens.harvard.edu

297. Virtual toxicology escape room: a novel method for providing toxicology education

Nicholas Titelbaum[a], Michael Simpson[b], Dazhe Cao[c] and Todd Phillips[c]

[a]Emory University, Atlanta, GA, USA; [b]Boston Children's Hospital, Brookline, MA, USA; [c]UT Southwestern Medical Center, Dallas, TX, USA

Background: The Coronavirus disease 2019 pandemic led to unprecedented changes to medical education as educators adapted to a world necessitating precautions and social distancing. In response to the pandemic, the Emergency Medicine Residents' Association (EMRA) committees' educational programming in association with the American College of Emergency Physicians 2020 Scientific Assembly (ACEP20), initially scheduled to be held in Dallas, TX, between October 26–29, 2020, transitioned to a fully virtual conference. Escape rooms have become popular recreational activities over the last several years. In-person escape rooms are structured around working in teams to solve a series of puzzles in a fictional scenario that allows participants to "escape" the room upon completion. The teamwork and problem-solving skills utilized in escape rooms lend themselves to use in medical education. The traditional in-person escape room format has previously been applied to toxicology for the purposes of providing engaging toxicology education to emergency medicine (EM) residents.

Methods: The researchers developed and led the first nationwide virtual toxicology escape room during ACEP20 using the Zoom

platform. The activities consisted of one web-portal linking to a sequence of four Google Forms multiple-choice question quizzes and four games made on Wordwall.net, a virtual educational activity creator. Six teams of 5 residents and medical students from residency programs across the country registered and participated for a total of 30 participants. Teams were split into Zoom breakout rooms, each moderated by at least one medical toxicologist and/or medical toxicology fellow. A survey was sent to participants to assess their overall experience with the activity.
Results: Every team completed all eight activities within 45 min. This activity demonstrates the feasibility of a large-scale, real-time competitive virtual escape room to engage participants and deliver toxicology education. The lessons learned from exploring virtual sessions like this one will be valuable tools in the future of medical education. Ten participants completed the survey. 80% of respondents reported that the event increased their interest in toxicology. 90% agreed that the format was easy to navigate, instructions were clear, questions were understandable, and toxicologists were well utilized in the event.
Conclusions: Toxicology-themed escape rooms have potential as virtual activities to educate EM residents on essential toxicology knowledge. While the small survey response rate limits the generalizability of this data, these initial results are promising and suggest that virtual escape rooms may be a viable option for increasing interest in toxicology among resident physicians.

KEYWORDS Resident education; escape room; virtual education

ntitelb@emory.edu

298. Salmonella infection after rattlesnake envenomation

Elizabeth Grossart[a], Ashley Lutrick[a], Linda Getsinger[b], Victor Waddell[b], Frank Walter[c] and Farshad Mazda Shirazi[d]

[a]Department of Emergency Medicine, University of Arizona, Tucson, AZ, USA; [b]Arizona Department of Health Services, Bureau of State Laboratory Services, Phoenix, AZ, USA; [c]The University of Arizona College of Medicine, Tucson, AZ, USA; [d]Arizona Poison and Drug Information Center, Tucson, AZ, USA

Background: Infection is uncommon after rattlesnake envenomation, occurring in <1% of patients. Prophylactic antibiotics are not recommended, and objective evidence of infection, such as a wound culture, is seldom sought. Human skin and snake oral flora may be introduced into punctures created by rattlesnake fangs. Studies have shown that rattlesnake venom also has antibacterial properties. We present a case of rattlesnake envenomation complicated by locally extensive Salmonella infection requiring surgical debridement and prolonged antibiotics.
Case report: A 3-year-old girl presented to the emergency department via EMS. She was bitten on the right foot by a western diamondback rattlesnake (Crotalus atrox) inside her family's home. On exam, she had two punctures on the medial aspect of her foot, ecchymosis, and edema that rapidly progressed to mid-shin. Labs revealed normal platelets and fibrinogen but a white blood count of 16.8K/mm^3. A loading dose of 10 vials of crotalidae immune F(ab')$_2$ (equine) (AV) was administered. Plain films showed soft tissue edema but no subcutaneous emphysema or foreign body. In the PICU, she received an additional 24 vials of AV to achieve local control. Nonetheless, she developed a hemorrhagic bulla that eventually encompassed the dorsum of her foot. Three days after envenomation, she had fever and worsening leukocytosis. Her fibrinogen increased to 790 mg/dL. Clindamycin and ceftriaxone were initiated, and 4 vials of AV were administered. She developed tachycardia, rigors, and intractable foot pain, and her fibrinogen rose to 989 mg/dL. Her CRP was markedly elevated at 225.2 mg/L. Emergency incision and debridement yielded purulent material and she underwent fasciotomy concurrently. Wound cultures grew *Salmonella enterica* subsp. arizonae serotype IIIa18:Z4, Z32: susceptible to ampicillin, ciprofloxacin, and trimethoprim/sulfamethoxazole. Another 10 vials of AV were infused post-operatively, and clindamycin was changed to piperacillin/tazobactam. MRI of the right foot and ankle suggested osteomyelitis of the cuneiform, navicular, cuboid, calcaneus, talus, and first metatarsal shaft. She underwent serial irrigation and debridement, and wound coverage was accomplished by anterolateral thigh free flap and split thickness skin graft. She was transitioned to amoxicillin twice daily for 6 weeks.
Discussion: Cytotoxic tissue damage is a known effect of rattlesnake envenomation. Local tissue injury may resemble necrotizing fasciitis, but true infection is rare. Salmonella osteomyelitis is known to occur in children with hemoglobinopathies and rarely in healthy children. Testing for hemoglobinopathy was negative in our patient. Salmonella infections, including osteomyelitis, have been reported in children who live with pet reptiles. The rattlesnake in this case was not a pet, but the child was bitten inside her home. *Salmonella* spp. have been identified in the venom and oral flora of non-captive rattlesnakes; deep punctures by fangs of larger snakes may inoculate deeper tissues and facilitate spread to bone.
Conclusions: Severe infections may occur after rattlesnake envenomation. Up-trending fibrinogen may herald the development of infection complicating snakebite. Although prophylactic antibiotics are not warranted in rattlesnake envenomations, advanced imaging, wound/tissue cultures, and serotyping are helpful in guiding antibiotic and surgical care in suspected infections.

KEYWORDS Salmonella; envenomation; rattlesnake

elizabeth.grossart@gmail.com

299. Management of discarded radiation source material by poison center

Joseph Clemons

Oregon Health and Science University, Portland, OR, USA

Background: Poison centers (PC) consults regarding radiation exposures are not frequent. PC staff needs knowledge on topics such as the safety and physical profile of radioactive materials, the health effects of radiation exposure, and the management of radiologic exposures.
Case report: A 32-year-old male contacts the PC regarding concern for possible radiologic exposure to himself and his three roommates. The caller states that his household has been attempting to build a "three-dimensional printer." The group would purchase and disassemble discarded industrial equipment from local scrap dealers to build their device. Recently, the household purchased a large unmarked metal box in the hopes of finding useful material. Upon disassembly, the group found a silver metallic object encased in a protective glass shielding with "POLONIUM-210 250 uCi" written on its face. The patients stated that they were in contact with the device for approximately 1.5 h before calling the PC. The individuals denied any attempts to damage, modify, or ingest the device. They stated that they had only removed the glass shielding from the device. Before contacting the PC, the household had showered, changed clothing, and left the premises. PC staff consulted the Radiation Emergency Assistance Center/Training Site (REAC/TS). REAC/TS confirmed that the device was most likely an improperly disposed of the industrial device and posed a low risk of causing

radiologic poisoning. PC staff consulted the state Radiation and Protection Service (RPS) to help arrange for the disposal of the polonium-210. Emergency medical services (EMS) were then dispatched to the residence to aid in removal and disposal. The device was placed into a metal box and disposed of at a facility equipped to handle radioactive materials.
Discussion: Polonium-210 undergoes almost pure alpha particle decay. This high-energy–low-penetration radiation cannot penetrate paper or the epidermis. It decays quickly, with a half-life of 138 days. If absorbed into the bodily system through inhalation or ingestion, polonium-210 can be highly toxic to major organs, DNA, and the immune system. Polonium-210 can be used in static elimination devices employed in various industries or to check and calibrate instruments. Customers who purchase the devices must comply with safe storage, operation, and disposal regulations. REAC/TS is a US Department of Energy-funded center that provides emergency response and subject matter expertise on the medical management of radiation incidents. They maintain a 24/7 national hotline that provides radiation-related expertise to help PC staff manage radiation emergencies. Likewise, the state RPS can help coordinate a response to a radiological emergency. Finally, EMS can be utilized to help aid in the disposal of radiologic sources.
Conclusions: PC sites may be unfamiliar with identifying and managing various radioactive materials. Federal and state resources such as REAC/TS, RPS, and EMS are invaluable assets that PC sites can utilize to improve the management of radiologic exposures.

KEYWORDS Radiation; polonium; exposures

clemons@ohsu.edu

300. Rare envenomation by a gaboon viper

Mary Lark and Jarratt Lark
Grand Strand Medical Center, Myrtle Beach, SC, USA

Background: The Gaboon viper is a venomous snake endemic to West Africa known for producing large amounts of venom. Effects of envenomation include coagulopathy, local cytotoxicity, cardiotoxicity, and hypotension, and bites can be fatal. Because of the snake's passive nature and habitat confined to rainforest areas, bites are rare, with few reported in the literature. However, the snake has gained popularity with collectors in the US, and handling can lead to envenomation.
Case report: A 29-year-old male presented to the emergency department as a level 1 trauma 2 h after being bitten on the right hand by his Gaboon viper. The patient presented with swelling of the right hand, arm, and face, oropharyngeal bleeding, and ecchymosis of the back, abdomen, and leg. The patient was subsequently intubated for respiratory failure, and mass transfusion protocol was initiated. He was administered cryoprecipitate, vitamin K, and PCC for coagulopathy. The patient was started on vasopressin, epinephrine, and norepinephrine, with persistent shock, and initial lactate of 11.4. Blood cultures tested positive for *Kytococcus sedentarius* and *Kocuria varians*, for which he was given ceftriaxone and metronidazole. The patient developed an acute kidney injury thought to be secondary to ischemic acute tubular necrosis, and hemodialysis was initiated. After developing coagulative necrosis in his third finger, the patient underwent amputation of this digit, serial debridement of the hand wound, and tissue grafting. Tissue cultures grew multidrug resistant *Pseudomonas*, and the patient was administered vancomycin, cefepime, and metronidazole. He then developed a second acute kidney injury from vancomycin, prompting a change in his antibiotic regimen to daptomycin and meropenem. After demonstrating clinical improvement, the patient was discharged with follow up with nephrology, infectious disease, and plastic surgery.
Discussion: As demonstrated in this patient, venomous snake bites can cause a range of physiologic effects, from tissue damage to hemodynamic instability. Venom induced consumptive coagulopathy (VICC) is the most common coagulopathy resulting from snake bites, and is treated by administration of antivenom. This patient presented with a depressed fibrinogen in the days after his bite, typical of VICC in Gaboon viper bites, which began to correct after the patient received multiple vials of antivenom. The patient's platelet count follows a similar trend, further suggestive of a consumptive coagulopathy. Due to his coagulopathy, the patient required massive transfusion, receiving over 40 units of blood products in the initial days after his bite. A final consideration for this patient was his renal injuries requiring dialysis. Snake bites are known to cause acute kidney injury, and do so by multiple mechanisms. Thrombotic microangiopathy may damage the kidneys, as well as direct cytotoxicity of venom and rhabdomyolysis. Decreased renal blood flow secondary to hemorrhage may also contribute to renal injury, further stressing the importance of control of venom induced coagulopathy.
Conclusions: This case report demonstrates numerous effects of a rare envenomation by the Gaboon viper, including consumptive coagulopathy, shock, and tissue necrosis. Other important considerations for this patient included kidney injury and infection.

KEYWORDS Gaboon viper; venom induced consumptive coagulopathy; snake envenomation

maryclairelark@gmail.com

301. Intravenous kratom use with peripheral vasospasm

Alex Riggs, Jennifer Briggs, Will Goodrich and Gavin Gardner
Oklahoma State University, Tulsa, OK, USA

Background: Kratom is a psychoactive substance derived from *Mitragyna speciosa* native to Southeast Asia and Africa. Its sale and use as an herbal supplemental is contentious as its safety profile is under debate. It is commonly used recreationally for pain management, avoidance of opioid withdrawal, and mood disorders. Stimulant effects predominate at low doses, while opioid effects are found with higher doses. The main pharmacologically active metabolites are mitragynine, 7-hydroxy mitragynine, and corynantheidine. Less commonly discussed, mitragynine possesses post-synaptic $\alpha 2$ receptor agonism. Use generally involves ingestion or inhalation. Intravenous administration is rare, with only one previously documented case notable for superficial thrombophlebitis.
Case report: A 52-year-old male presented to the emergency department for left arm pain following IV use of kratom approximately 12 h prior. He experienced progressive worsening of pain with decreased sensation and strength of his left hand. He had significant mottling to the left forearm extending distally in a stocking-like distribution. There was a palpable distal radial pulse; however, digital capillary refill was absent. There was a small wound at the injection site, but no overt signs of infection. Despite palpable pulses, the patient's presentation was concerning for vascular occlusion. A left upper extremity arteriogram showed sluggish pulsatile flow within the radial, ulnar and interosseous arteries consistent with significant vasospasm. There were no identified emboli or thrombi. Intravenous nitroglycerin was unsuccessful at restoring flow. Intra-arterial verapamil and nitroglycerin were infused, and he was admitted to the ICU for frequent neuromuscular monitoring. Despite interventions, he had worsening of his extremity ischemia, and developed

compartment syndrome that required fasciotomy. He was discharged home with subsequent amputation of digits 2–5 of the left hand secondary to dry gangrene.
Discussion: Kratom is a unique substance producing varying dose-dependent stimulatory or opioid effects. It is typically ingested orally as a tea or in capsules as a supplement. Lesser known regarding the chemical component mitragynine is the agonistic effect it exerts on post-synaptic α2 receptors. Kratom has been described as similar to yohimbine, which has well known adrenergic properties. Peripheral α2 agonism causes vasoconstriction. This patient took a substance intended for oral use, and injected it intravenously. The exact dose he prepared for injection was unknown. Furthermore, kratom is not well regulated, and was possibly contaminated with other substances or adulterants. However, this patient experienced a profound vasospastic effect after injection, which highlights differing effects of kratom when bypassing first pass metabolism. There has only been one documented case of intravenous use of kratom. This case suggests that alpha stimulation is more profound when kratom is intravenously administered.
Conclusions: Our case presents a unique presentation of intravenous administration of kratom complicated by development of arterial insufficiency, acute compartment syndrome, and rhabdomyolysis. This suggests that kratom has a more profound effect on post-synaptic α2 receptors than previously discussed, and can lead to vasospasm and ischemia if intravenously administered.

KEYWORDS Kratom; intravenous; vasospasm

alex.riggs@okstate.edu

302. Complicated management of opioid withdrawal from massive chronic loperamide ingestion

Noah Berland[a], Lewis Nelson[b], Diane Calello[a], Bruce Ruck[c] and Meaden Christopher[a]

[a]Rutgers NJMS NJPIES, Newark, NJ, USA; [b]Rutgers New Jersey Medical School, Demarest, NJ, USA; [c]NJPIES, Watchung, NJ, USA

Background: Loperamide, an over-the-counter opioid antidiarrheal, can be misused in high doses by patients with opioid use disorder. As a substrate of p-glycoprotein (PGP), is rapidly removed from the CNS, conferring a safety profile allowing for its over-the-counter availability; however, massive ingestion or co-ingestion with a PGP inhibitor can overcome this protection. Loperamide exhibits profound QT prolongation and L-Type calcium channel blockade at escalating doses. There are multiple cases of dysrhythmias and death in the setting of loperamide abuse.
Case report: A 42-year-old male presented to the ED for syncope, having received intravenous lidocaine en route by EMS for suspected ventricular tachycardia. Initial ECG: ventricular rate of 42 bpm with a QT of 780 ms and a QTc of 684 ms. The patient then went into cardiac arrest with ventricular fibrillation: ACLS was initiated, and ROSC was achieved. He underwent cardiac catheterization, which revealed no vascular occlusion. A transvenous pacer was placed for overdrive pacing. Additional history revealed that the patient was taking 100 mg daily of oxycodone for lower back pain daily 3 years prior to presentation. At that time, he transitioned to loperamide and increased his daily dose to 800 mg over time, and started taking magnesium citrate and ascorbic acid for constipation which he last took the day prior to presentation. The patient started to complain of opioid withdrawal on hospital day 2 and had a clinical opioid withdrawal scale of 10. The patient was given 32 mg of sublingual buprenorphine with worsening withdrawal symptoms noted, which was concerning for precipitation of worsening withdrawal. A second dose of 32 mg of sublingual buprenorphine, 1.8 mg of intravenous buprenorphine, clonidine, and diazepam were administered, and decreased withdrawal symptoms. The patient was then switched to chemical overdrive pacing with isoproterenol. On hospital day 3, the patient's withdrawal was well controlled on standing 8mg q8hr sublingual buprenorphine. The patient's symptoms and electrocardiographic abnormalities resolved, and he was discharged on hospital day 6, has since successfully followed up with addiction medicine as an outpatient, and has continued buprenorphine for opioid use disorder. Loperamide levels were obtained and were consistent with the chronic massive ingestion history (admission: loperamide 87 ng/mL, desmethyl loperamide 410 ng/mL. hospital day 2: loperamide 52 ng/mL, desmethyl loperamide 230 ng/mL)
Discussion: Patients with opioid use disorder have been more frequently using high doses of loperamide for self-treatment of withdrawal symptoms: however, high doses of loperamide causes QT prolongation with concomitant bradycardia, which can result in death due to ventricular dysrhythmias. Our patient experienced severe opioid withdrawal requiring multiple high doses of buprenorphine and other adjunctive therapies.
Conclusions: We report a case of massive loperamide overdose resulting in ventricular dysrhythmias, that was successfully treated with overdrive pacing and survived, with severe opioid withdrawal managed with high doses of buprenorphine. This successful induction was faster than most in the literature but was complicated by precipitated withdrawal, one might consider a rapid micro-dosing induction of buprenorphine for future cases.

KEYWORDS Loperamide; opioids; buprenorphine

Noah.berland@gmail.com

303. Sustained return of spontaneous circulation after cardiac arrest from a sodium nitrite overdose

Sarah Hsu[a], Priya Srihari[b] and Alexander Lee[b]

[a]LAC USC Medical Center, Los Angeles, CA, USA; [b]Keck School of Medicine of USC, Los Angeles, CA, USA

Background: Sodium nitrite is an inorganic salt used as a food preservative and an antidote to cyanide toxicity. Recently, there has been a dramatic increase in suicide attempts by intentional ingestion of sodium nitrite. It is a strong oxidizing agent that leads to the formation of methemoglobin (MetHgb). This clinically manifests as cyanosis, hypoxia, dysrhythmias, coma, and death. Elevated MetHgb levels are detected by co-oximetry. The antidote for methemoglobinemia is methylene blue, typically starting at a dose of 1–2 mg/kg. There is a high rate of morbidity and mortality reported in cases of intentional sodium nitrite ingestion. Among patients who develop cardiac arrest from sodium nitrite ingestion, to our knowledge none have successfully been resuscitated to obtain sustained return of spontaneous circulation (ROSC).
Case report: An approximately 50-year-old male was brought to the Emergency Department after intentionally ingesting a 500-g bottle of sodium nitrite. The patient arrived pale, cyanotic, and hypoxic despite supplemental oxygen. Initial blood pressure was 127/98 mm Hg, heart rate was 95 beats per minute, and oxygen saturation was 88% on 15 L of oxygen via non-rebreather mask. The patient was intubated upon arrival; an arterial blood gas (ABG) revealed a MetHgb of >30% (the upper limit of detection) and an oxyhemoglobin of 13%. Shortly after, the patient lost pulses and received eleven rounds of cardiopulmonary resuscitation (CPR) with epinephrine, with brief periods of ROSC achieved after each round. 1 mg/kg of methylene blue was given while

CPR was ongoing, with a post-ROSC ABG showing a MetHgb level still >30%. A second dose of methylene blue at 6mg/kg was recommended by Poison Control, however only 3 mg/kg was given based on hospital availability. A final ABG demonstrated a MetHgb level of 0.9%. Prior to the final sustained ROSC, the patient had been hemodynamically unstable on maximum doses of norepinephrine, epinephrine, and vasopressin. After the second methylene blue administration, the patient was de-escalated to just epinephrine. Computed tomography of the patient's head showed global anoxia and the patient's neurological exam was unfavorable. Brain death was formally declared on hospital day 3. It was later discovered that the date of birth had been inaccurately documented and the patient was only 28 years old.
Discussion: In this case of severe methemoglobinemia, the patient was successfully resuscitated from cardiac arrest after receiving high doses of methylene blue and CPR. To our knowledge, this has yet to be reported from an intentional sodium nitrite ingestion. Although numerous rounds of CPR were performed prior to obtaining sustained ROSC, the patient did have up to 2 min of ROSC after each round, motivating the team to continue efforts. Sustained ROSC and subsequent de-escalation of vasopressor requirements were only achieved after a large single dose of methylene blue.
Conclusions: Significant methemoglobinemia can result from toxic sodium nitrite ingestions, often causing serious outcomes including death. Large doses of methylene blue should be considered for patients presenting in cardiac arrest.

KEYWORDS Methemoglobinemia; cardiac arrest; methylene blue

snchsu@gmail.com

304. When are poisoned patients transferred?

Lesley Pepin[a], William Boroughf[b], Christopher Hoyte[c] and Daniel Spyker[d]

[a]Denver Health, Denver, CO, USA; [b]University of Colorado, Aurora, CO, USA; [c]Rocky Mountain Poison and Drug Center, Denver, CO, USA; [d]Oregon Health and Science University, Portland, OR, USA

Background: Poison centers (PCs) support providers managing poisoned patients across diverse hospital settings. Critical access hospitals (CAH) and rural acute care hospitals (Rural) are among the more resource limited environments treating poisoned patients. Most CAH are small and distant from other hospitals. Rural hospitals are outside of metropolitan centers. Limitations in services at these sites may necessitate patient transfer to a larger facility. Transfers can be costly for these financially vulnerable hospitals and patients. PCs aim to mitigate unnecessary healthcare spending. Understanding factors associated with transfer can help with this aim. The purpose of this study is to examine case features most associated with transfers of the adult poisoned patient.
Methods: We retrospectively reviewed reported exposures to a large, US PC originating from CAH and Rural from January 1, 2015 to December 31, 2021. Adults (>18 years) with medical outcomes of no effect, minor, moderate, major effect or death were included. Case features evaluated included: age, sex, year of case, number of substances, health care facility (CAH or Rural), state of origin, reason for exposure (intentional, unintentional, adverse reaction, other – withdrawal, malicious, contamination, or unknown), highest level of care (medical unit, psychiatric unit, treated/released or unknown), medical outcome, medical toxicologist consulted, antidotal therapies used, critical care therapies used (as both binary and as individual therapies). Bivariate analyses and stepwise logistic regression identified variables most strongly associated with patient transfer via SAS JMP (v 16.0.0).
Results: There were 101,654 exposures reported from health care facilities identified in the studied time period; 14,579 met inclusion criteria. Of these, 8034 (55%) were female, median age 35 (IQR 27) years. There were 7376 (51%) cases reported from CAH. In total, 942 (6.4%) cases were transferred. Bivariate analysis showed 13 of the 17 case features were strongly associated with transfer ($p < 0.0001$). Age ($p = 0.001$), transplantation (1 case) $p = 0.0192$), age ($p = 0.001$) gender and lipid emulsion ($p > 0.05$) were not as strongly associated. Logistic stepwise analysis showed features most strongly associated with transfer (in order of contribution): highest level of care, health care facility type, invasive ventilation, use of antidotal therapies, medical outcome, medical toxicologist involvement, reason for exposure, dialysis/CRRT therapy, case year.
Conclusions: Transfers were uncommon within the study group with a rate of 6.4%. Not, surprisingly, the features associated with transfer reflect the severity of patient illness and hospital resource limitations. Use of antidote and critical care therapies – renal replacement and intubation, cases utilizing toxicologist guidance, moderate or major effect outcomes, intentional exposure were all significantly associated with patient transfer. The analysis suggests appropriate consideration and utilization of this expensive resource in PC cases. Unfortunately, the granularity of PC data is limited. Continuing efforts to prospectively evaluate our management of poisoned patients in these rural communities is critical.

KEYWORDS Patient transfer; rural toxicology; poison center

lesley.pepin@rmpds.org

305. High-dose insulin in end-stage renal disease: delay to elimination?

Rebecca Meiners[a], Justin Corcoran[b], Jon Cole[a] and Ryan Fuchs[c]

[a]Minnesota Poison Control System, Minneapolis, MN, USA; [b]Medical College of Wisconsin, Menomonee Falls, WI, USA; [c]Hennepin County Medical Center, Minneapolis, MN, USA

Background: Amlodipine is a dihydropyridine calcium channel antagonist (CCA) with predominantly vasodilatory effects; however, significant overdoses also manifest with additional cardiogenic shock. Patients with refractory vasodilatory shock secondary to CCA toxicity are often treated with high-dose insulin (HDI), which is known to cause prolonged dextrose requirements for 24 h or longer after insulin is discontinued. In patients with functional kidneys, insulin has meaningful renal clearance, and as such, patients with ESRD could be at risk for delayed insulin clearance and prolonged hypoglycemia. We report a case of amlodipine overdose in an ESRD patient requiring HDI, after which measured insulin levels remained supraphysiological for an extended period in the setting of prolonged dextrose needs.
Case report: A 45-year-old, 62.2 kg man with a history of dialysis-dependent ESRD and no history of diabetes presented to a large urban hospital after endorsing taking 300 mg of his amlodipine. He was hypotensive and bradycardic and was intubated. He subsequently received IV fluids, calcium gluconate, norepinephrine, and vasopressin. Cardiac ultrasound showed cardiogenic shock with depressed ejection fraction and relative bradycardia. HDI was at 1 unit/kg/h without plans to increase that dose, due to concerns for delayed insulin clearance in ESRD. Cardiac contractility improved, then declined. He continued on norepinephrine and vasopressin, and was started on angiotensin II, epinephrine, phenylephrine, and HDI was titrated up to 10 units/kg/h. With concern for ongoing significant hypotension, the patient received methylene blue and IV fat emulsion which failed

to affect hemodynamic status. He was not a candidate for ECMO. CRRT was discontinued when the filter clotted, but ultimately was successful starting on hospital day 2. Bedside ultrasound showed good cardiac contractility on 10 units/kg/h of insulin. HDI continued for a total 40 h, at an overall average rate of 5.91 units/kg/h. Four hours before HDI was discontinued, the patient's insulin concentration was 172 mcIU/mL (fasting reference range 3–19 mcIU/mL, non-fasting range not established). 20 h after HDI was discontinued, an insulin concentration >1000 mcIU/mL was obtained; this subsequently downtrended and normalized by 140 h post-discontinuation. Over this time, he had gradually-downtrending dextrose requirements (see graph), with one single hypoglycemic episode at 26 h post-HDI.
Discussion: In this patient with ESRD treated with HDI, the patient required dextrose for over 6 days past discontinuation of HDI. HDI in and of itself, but particularly in the setting of ESRD, makes for unique insulin kinetics. The expected half-life of regular insulin when given IV at usual doses for hyperglycemia is 6–9 min. Under usual circumstances insulin is metabolized >50% by the liver, approximately 30% by the kidneys, and approximately 20% by adipose tissue. The usual renal clearance of insulin is 200 mL/min.
Conclusions: Clinicians should be aware that prolonged, continuous dextrose infusions may be required in significant dihydropyridine CCA overdoses for long after HDI is discontinued. This case suggests this issue may be even more pronounced in patients with pre-existing renal failure, as renal failure may slow insulin clearance, potentially extending the length of time dextrose supplementation is needed.

KEYWORDS Amlodipine; insulin; dextrose

Rebecca.Meiners@hcmed.org

306. Precipitated withdrawal following misuse of Lybalvi® (olanzapine/samidorphan)

Sam Wagner[a], Craig Smollin[a], Nathan West[a], Raymond Ho[b] and Kathy LeSaint[a]

[a]University of California, San Francisco, San Francisco, CA, USA; [b]CA Poison Control System, San Francisco, CA, USA

Background: Lybalvi®, a combination of olanzapine and samidorphan, was approved in June 2021 for the treatment of schizophrenia and/or bipolar 1 disorder in adults with samidorphan primarily functioning to mitigate the weight gain associated with olanzapine. The medication is contraindicated in patients using opioids or undergoing acute opioid withdrawal as samidorphan, 3-carboxamido-4-hydroxynaltrexone, is a mu-opioid receptor antagonist in vivo. It has a half-life of 7–9 h and is structurally related to the mixed opioid receptor antagonist naltrexone; however, samidorphan has a five-fold greater affinity at the mu-opioid receptor and much greater bioavailability. Data is limited regarding post-marketing episodes of precipitated opioid withdrawal induced by Lybalvi®. We report a case of precipitated withdrawal in a patient with fentanyl use disorder with resolution of symptoms after supportive care.
Case report: A 44-year-old man with a history of fentanyl use disorder presented to the emergency department (ED) with symptoms of restlessness, tremor, muscle aches, persistent nausea and non-bloody, non-bilious emesis that started within an hour after intentionally taking his partner's prescribed Lybalvi® for the purpose of treating pain. Three hours after symptoms started, the patient attempted to self-treat by smoking $^1/_2$ gram of fentanyl. His symptoms persisted, and he presented to the ED approximately 8 h after his fentanyl use. The patient's triage vital signs were notable for tachypnea (respiratory rate 22 breaths/min), and physical exam was notable for being alert but with periods of disorientation. A Clinical Opiate Withdrawal Scale (COWS) was not documented. Blood tests were unremarkable. The patient received supportive treatment with intravenous fluids and ondansetron with resolution of symptoms. Upon discharge 4 h after arrival, he was advised to discontinue use of Lybalvi® in the future and prescribed naloxone.
Discussion: This patient with chronic opioid use disorder experienced acute samidorphan-induced precipitated withdrawal which was partially self-treated with fentanyl. In the emergency department, he was treated with supportive management with resolution of his symptoms. This case was reported to the FDA Safety Information and Adverse Event Reporting Program.
Conclusions: Clinicians should be aware of the recently approved Lybalvi® (olanzapine/samidorphan) and the potential for samidorphan to cause precipitated withdrawal in patients with opioid use disorder or opioid dependence.

KEYWORDS Lybalvi AKA Olanzapine/Samidorphan; precipitated withdrawal; opioid use disorder

travel4747@icloud.com

307. Variations in toxic alcohol lab testing practices across american poison centers

Diana Dean, Alexandra Funk and Justin Arnold

Florida Poison Information Center – Tampa, Tampa, FL, USA

Background: Toxic alcohol quantitative testing is performed by specialized gas chromatography methods that are not universally available at all US hospitals. Thus, management decisions in the care of patients poisoned with toxic alcohols (TAs), specifically methanol (MeOH) and ethylene glycol (EG), are often made without quantitative levels and are expected to be highly variable given the heterogeneity of resources. The objective of this study is to describe availability of toxic alcohol testing and how US poison centers (PCs) manage cases based on availability of quantitative toxic alcohol testing in the areas they serve.
Methods: A thirteen question survey was distributed to all 55 US PC managing and medical directors via electronic mail. Questions pertained to availability of TA testing at "home" institutions and "send out" testing. Expected turnaround times for different methods of testing and the concurrent use of various clinical parameters were also assessed. One response per center was utilized as instructed to best represent their centers' practice patterns.
Results: There were 41 responses recorded and we utilized 36 responses;. Regionality of responses is demonstrated in Chart 1. Chart 2 demonstrates how TA testing is primarily performed at each PC's host institution. Turnaround times (TAT) are less for host institution labs (expected within 8 h) with 12 (85%) expecting results in 4–6 h or less. "Send out" testing occurs at 22 (61%) of PC's home institutions, with 5 centers (22%) reporting expecting results in <6 h and 11 centers (50%) reporting TAT >24 h. When assessing each PCs regional practice, twenty-two centers report 10% or less of hospitals in their region have access to TA testing with TAT less than 24 h. Seven centers (20%) report all hospitals in their region can obtain TA testing within 24 h. Most centers (67%) report their staff facilitate TA testing, with commonly listed means include providing lists of laboratories who perform in their region, specifically instructing to send STAT, or notifying receiving laboratories to expect a sample and following up with the testing laboratory. Most respondents (67%) report the knowledge of how an institution handles TA testing plays into their medical decision making. Interestingly, some centers report although TA testing was available to certain hospitals they cover, the cost of TA testing or lack of established laboratory

contracts were cited as reasons a hospital would not perform recommended testing even though it was available. There are many limitations to this study as there is significant heterogeneity in the geographical regions covered by US PCs with respect to hospital affiliations and resources. Two respondents reported they were not affiliated with a hospital and abstained from survey. Additionally, there are inherent practice variations amongst toxicologists who responded, and respondents may not accurately represent the individual practices at their centers.
Conclusions: There is wide practice variation in toxic alcohol testing patterns and management of these cases. Further studies should be performed to address variations in costs (send out vs in house testing) when coupled with costs of inpatient treatment (i.e., fomepizole or dialysis) for this specific poisoned population.

KEYWORDS Toxic alcohol; lab testing; poison center

dianadeanmd@yahoo.com

308. Massive lacosamide overdose with severe neurologic and cardiac poisoning

Kai Li[a] and Steven Offerman[b]

[a]Kaiser Permamente, San Leandro, CA, USA; [b]Kaiser Permanente, Sacramento, CA, USA

Background: Lacosamide (Vimpat) is an antiepileptic medication used in the treatment of partial onset seizures and as an adjuvant in the treatment of primary generalized tonic-clonic seizures. Its mechanism of action is through selective enhancement of slow inactivation of voltage-gated sodium channels and through possible interactions with collapsin response mediator protein-2. Significant lacosamide overdoses are considered rare. Experimental studies and clinical trials suggest that lacosamide's effect on cardiac sodium channels causes a dose-dependent risk of cardiac arrhythmias. Three cases of cardiac arrest associated with lacosamide overdose have been reported previously. However, past reports have been in abstract form or associated with multiple drug overdoses.
Case report: A 26-year-old female with a history of epilepsy presented to the Emergency Department (ED) with mental status changes. The patient was found unresponsive in her room thirty minutes after an argument. On paramedics arrival, the patient was actively seizing and had blue-colored emesis. She was found with four empty bottles of blue, 200 mg lacosamide tablets. The patient was given midazolam in the field with termination of seizures. On ED arrival, she was intubated for airway protection and became bradycardic and pulseless requiring one round of cardiopulmonary resuscitation (CPR) with return of spontaneous circulation (ROSC). The patient again became bradycardic and pulseless and received CPR and epinephrine with ROSC. Electrocardiogram (EKG) at this time showed a wide complex tachycardia treated with two amps of sodium bicarbonate with narrowing of the QRS. She underwent 4 h of hemodialysis and then developed runs of sustained VT requiring defibrillation (×4) and treated with more sodium bicarbonate. The patient was started on a lidocaine, sodium bicarbonate, and hypertonic saline infusions during the first 24 h from time of overdose. Serum lacosamide level on presentation was >40 μg/mL (therapeutic 1.0–10.0 μg/mL). Repeat levels sent following hemodialysis continued to be greater than the level of detection (>40 μg/mL). On hospital day 3, the patient again became bradycardic to the 40s and went into asystole. She was treated with multiple rounds of CPR, epinephrine, bicarbonate and lidocaine pushes. She developed one episode of ventricular tachycardia that resolved after defibrillation. She also developed hypoxemia with chest x-ray showing bilateral lower lobe collapse likely due to aspiration pneumonia. The patient was extubated on hospital day 6. She was discharged to a psychiatric facility on hospital day 11.
Discussion: Most documented cardiac toxicity from either therapeutic use or overdoses of lacosamide are limited to ST-wave and T-wave abnormalities and slight lengthening of the PR interval and QRS duration. Atrioventicular (AV) blockade, atrial flutter, atrial fibrillation, sinus pauses and ventricular tachycardia have also been described in the literature. The patient's prolonged period of cardiotoxicity and recurrent episodes of cardiac arrest likely resulted from her ongoing toxicity reflected in the significantly elevated serum lacosamide levels even following hemodialysis.
Conclusions: We describe a case of severe, intentional lacosamine overdose resulting in multiple episodes of cardiac arrest.

KEYWORDS Lacosamide; Vimpat; cardiac arrest

spudazzle@gmail.com

309. Unintentional pediatric cannabis exposures reported to a single poison control center: a comparison of outcomes of confirmed cannabis ingestions to unconfirmed cannabis ingestions

Sarah Mahonski[a], Nicole Barney[b], Brooke Hoots[c], Kristin Holland[c], Maria Mercurio-Zappala[d] and Mark Su[d]

[a]NYU Langone Medical Center/Bellevue Hospital Center, New York, NY, USA; [b]Department of Pediatrics, NYU Grossman School of Medicine, New York, NY, USA; [c]Division of Overdose Prevention, National Center for Injury Prevention and Control, CDC, Atlanta, GA, USA; [d]New York City Poison Control Center, New York, NY, USA

Background: With states increasingly legalizing nonmedical adult cannabis use and diversity of cannabis products (e.g., edibles), multiple studies report increased frequency of poison control center (PCC) consults related to unintentional pediatric cannabis exposures. Compared to adult ingestions, pediatric cannabis exposures result in more severe adverse health effects. However, pediatric cannabis reports to PCCs are not usually confirmed and solely based on patient history. Prior literature reports major effects after cannabis exposures in pediatrics to be rare at less than 2%. In this study, we compare patient outcomes in a group of patients with confirmed cannabis ingestion via a qualitative urine drug screen compared with patients exposed to cannabis without confirmation.
Methods: This was a retrospective observational study of pediatric cannabis exposures identified from the XXX PCC from January 1, 2000 to December 31, 2021. Cases ages 5 years and younger were identified in Toxicall via AAPC codes 310121, 130124, 310096, 310122, 310126, 310125, 310123, 310146, and 8300. Data extracted included patient age, gender, route of ingestion, clinical effects, treatment, disposition, outcome, duration of effect and results of urine drug screening. The data were entered into a REDCap database and analyzed using SAS 9.4. Patient characteristics with positive urine tetrahydrocannabinol (THC) and those without confirmatory urine testing were compared via Chi-Square and Fisher's exact test for categories with a small sample size. This project was approved by our institutional review board.
Results: From 2000 to 2021, there were 292 pediatric cannabis exposures reported to our PCC. Of these, 125/292 (65%) cases originated from health care facilities (HCF); the remainder were home calls. Focusing on 125 cases reported by healthcare

facilities, the most common symptoms were mental status changes with 56/125 (45%) having CNS depression, and 39/125 (31%) with drowsiness/lethargy. The most frequent documented treatment was intravenous fluids in 29/125 (23%). Fifty-nine patients (47%) had confirmatory testing for cannabis via urine drug screening. Seizures occurred in 7/59 (12%) patients with THC positive urine compared with no seizures in the non-confirmed group ($p = 0.004$). Intravenous fluids were administered more commonly in the THC positive urine group: 20/59 (34%) versus 9/66 (14%) in those without urine confirmation, $p = 0.007$. Intensive care unit admission occurred in 28/59 (47%) patients with THC positive urine compared with 11/66 (17%) of patients without urine confirmation ($p = 0.0002$) and "major effects" were seen in 10/59 (17%) with THC positive urine compared to 1/66 (2%) without urine confirmation ($p = 0.002$).

Conclusions: Unintentional cannabis ingestion can result in severe effects in children. Looking specifically at a confirmed group of pediatric cannabis ingestions based on urine drug screening, major effects such as mental status changes and seizures, as well as requirement for intravenous fluids and ICU admission occurred more frequently in confirmed versus unconfirmed cannabis cases. Pediatric patients with confirmed cannabis exposures should be closely observed in a health care setting for the occurrence of significant adverse effects.

KEYWORDS Pediatric; cannabis; unintentional

sarah.g.mahonski@gmail.com

310. Emesis nemesis: descriptive analysis of pediatric ondansetron ingestions

Crystal Proshek[a], Patrick Filkins[a] and Stephanie Hon[a,b]

[a]Georgia Poison Center, Atlanta, GA, USA; [b]Grady Health System, Atlanta, GA, USA

Background: Ondansetron, commonly known by brand names Zofran® and Zuplenz®, is a selective 5-hydroxytryptamine-3-receptor antagonist. It was originally manufactured for the prevention of chemotherapy-induced nausea and vomiting but recently is often prescribed off-label for other gastric issues. Pediatric ingestions of ondansetron have become frequently reported to regional poison centers (RPC). Children older than 4 years can be prescribed up to 12 mg daily and weight-based dosing has been considered for children under 4 years ranging from 3 to 12 mg daily. Literature describing ingestions of an estimated 1.25–6.4 mg/kg (60–64 mg) have resulted in moderate toxicity in children; however, literature is limited. Our aim is to report the incidence and outcomes of exposures involving ondansetron in children as reported by our RPC.

Methods: This is an IRB-approved retrospective chart review from January 2000 to December 2020, analyzing children 6 years or less with a history of single acute ingestion of ondansetron. Other inclusion criteria required a historical amount of ondansetron ingested and a documented outcome.

Results: Over a 20-year period, 741 cases of pediatric ondansetron cases were reported to our RPC. Only 207 cases met all inclusion criteria (27.9% of all cases). For all included exposures, the mean age was 2.4 years with 56% females. There were 38 cases describing exact known amounts ingested (18.4%), 71 estimated amounts (34.3%), and 98 were described as maximum possible (47.3%). The known exact amounts ranged from 2 mg to 104 mg, with a possible maximum amount of 220 mg. No effects were reported in 157 (75.8%) of the cases (mean 25 mg total, 1.9 mg/kg), 45 cases experienced mild to moderate effects (mean 53 mg, 3.9 mg/kg), and 2 cases exhibited major effects (mean 160 mg, 12.2 mg/kg). The most common symptoms reported were mild/moderate CNS depression in 30 cases (ranging from 4 mg to an estimated 232 mg, mean 4.6 mg/kg), and 11 cases with tachycardia (ranging from an estimated 24 to 232 mg, mean 6.3 mg/kg). Out of 207 cases, 80 (38.6%) were treated at home and 120 (57.9%) were evaluated in a hospital/clinic. Of those treated in a hospital, 22 (10.6%) were admitted, and 94 (45.4%) were treated and released from the ED. Most hospitalized patients received observation only ($n = 62$); 17 cases received activated charcoal, and 5 cases received anticonvulsants/sedation. The mean dose ingested that was recommended by the RPC to be managed onsite was 14.2 mg (1.0 mg/kg), compared to the mean dose ingested in which hospital triage was recommended was 45.6 mg (3.3 mg/kg).

Conclusions: Twenty years of data from our RPC suggests that with unintentional ingestions of ondansetron in children less than 6 years of age, most children experienced little to no toxic effects when the reported ingestion is below the recommended dose of 3–12 mg. Few cases resulted in moderate to major outcomes, with 14% experiencing CNS depression and 5% experiencing tachycardia. Children who are referred to a healthcare facility mostly require no intervention and are discharged from home after an observation period. Until further studies are concluded, any cases with more than minor symptoms should continue to warrant healthcare facility referral and evaluation. The inconsistency of coding and follow-up practices of the reporting poison center should also be taken into consideration.

KEYWORDS Ondansetron; pediatric; toxicity

cproshek@georgiapoisoncenter.org

311. Cannabis use during the perinatal period

Rachel Oliver, Hong Li and Teresa Dodd Butera

Azusa Pacific University, AzUSA, CA, USA

Background: The National Survey on Drug Use (2020) indicates that approximately 49.6 million people reported using cannabis sativa (marijuana) in the past year. Marijuana is the most widely used illegal drug during pregnancy, and exposures have increased in the US. Poison control centers track and report cannabis exposures and adverse-related events; and serve pregnant women as part of their overall services. US poison control centers reported a total of over 6000 pregnancy exposures from various sources in 2020. The purpose of this study was to review cannabis use in pregnancy and breast-feeding reported in the literature, with implications for public health education efforts to promote health equity. This was a scoping review conducted according to the guidelines of the PRISMA extension for scoping reviews.

Methods: Specifically, to identify relevant articles, MEDLINE® database and Google Scholar were searched from January 1, 2016 to June 31, 2021 in consultation with a professional research librarian. The key search terms used were pregnancy OR postpartum OR breastfeeding AND cannabis OR marijuana AND effect OR issue OR adverse. The database was filtered and a total of 182 articles were identified in the initial search of the electronic database. Additional search strategies uncovered 6 more potentially relevant articles from Google Scholar database. The titles of the 182 articles were screened for relevance. A total of 108 articles were deemed irrelevant to the research question. Then, full-text articles of the remaining 80 articles were assessed for eligibility. This was assessed on the following exclusion criteria: (1) cannabis use during preconception and (2) co-use of marijuana and tobacco products or any other recreational drug like alcohol or opioids; however, some articles were included if the studies had information regarding the sole use of marijuana.

Non-human studies were also excluded; along with studies focusing on childhood use of marijuana. With the completion of screening stages, 64 articles were selected for the final review and synthesis. Qualitative studies, systematic studies, cross-sectional studies, scoping reviews, and meta-analyses were included (see attached PRIMSA flow diagram). Results were categorized thematically, including risk factors for exposure; role of the health professional, cultural influences; regulatory influences; underreporting of use and systemic racism; marijuana dispensaries role; and impact and outcomes to the maternal-fetal dyad, including: placental transfer and presence in breast milk.

Results: In 2018 Holland et al. reported that 48% of providers did not provide counseling to patients who disclosed marijuana use Regardless of the similar prevalence rates of substance use during pregnancy between Black and White women, however, racial disparities were found at all levels, including initiation of testing, referral to drug treatment programs, and reporting to child protective services (CPS).

Conclusions: Public health measures for cannabis use in pregnancy are recommended, to include: Educating health professionals on cultural sensitivity, mandating warning labels on cannabis products, and expanding interprofessional collaboration between poison and teratogen specialists for appropriate counseling and follow up after exposures

KEYWORDS Cannabis; marijuana; drugs

racheloliver96@gmail.com

312. Yummy gummies in my tummy: the what and the when of pediatric edible cannabis exposures reported to a regional poison center 2018–2021

Antonia Nemanich[a], Marit Tweet[b] and Michael Wahl[c]

[a]Toxikon Consortium, Chicago, IL, USA; [b]Southern Illinois University, Springfield, IL, USA; [c]Illinois Poison Center, Chicago, IL, USA

Background: Accidental pediatric ingestions of edible cannabis products have been on the rise in recent years as cannabis is legalized in more states around the US. In Illinois, where it was legalized at the start of 2020, there was a 2036.4% increase in pediatric edible exposures reported to our regional poison center (RPC) between 2018 and 2022. Concentrated THC is added to various baked goods, drinks, or candies to make edible products. These may be particularly appealing to young children as the products resemble other treats that they routinely enjoy. Other factors that may contribute to children's accidental ingestions include witnessing adults partaking of such edibles at home, and exploratory ingestions of easily accessible products.

Methods: A retrospective chart review for ingestions coded as edible cannabis products in children less than 6 years of age for the four-year period 2018–2021 was performed. Data extracted included type of edible product ingested, patient age and gender. An NPDS data query was used to obtain the month and day of the week ingestions occurred.

Results: There were 431 unintentional pediatric edible cannabis exposures in children under 6 years reported to our RPC between 2018 and 2021. Edibles ingested included gummies, other candy ("Nerds," candy rope, lollipops, etc.), chocolate, brownies, cookies, cake, and other products. The specific edible type was unknown in 164 (38.0%) of cases. Of the 267 cases where the edible type was known, gummies accounted for 159 (59.6%) of these exposures, making it the most common edible ingested. Non-chocolate candy types, which include not only gummies but also treats such as lollipops, rope, etc accounted for 75.0% of known edible exposures. The timing of these ingestions was also examined to determine if they clustered around specific days of the week or months of the year, such as during weekends or school holidays when children may be spending more time in the home. There was a higher rate of ingestion on weekend days compared to weekdays. 34.0% of ingestions occurred on a Saturday or Sunday, and there was a statistically significant increase of 45% comparing ingestions on Friday–Sunday with those occurring on Monday–Thursday. As far as time of the year, June and July were the months with the highest number of exposures, (47 and 50 respectively). However, August tied with February as having the lowest number of exposures at 26, and there was no clear seasonal trend.

Conclusions: Cannabis edibles in the form of candy, especially gummies, seem to be particularly appealing to children and make up the majority of pediatric edible exposures in Illinois. Edible exposures seem slightly more likely to occur on weekends, which may possibly be related to when children are spending more time in the home. Efforts to reduce unintentional exposures in this age group should focus on family education regarding keeping edibles inaccessible to children in the home, as well as changes in packaging and labeling. Opaque packaging that resembles medication rather than snacks, individual wrapping of the edibles, and clear warning labels about THC content would likely be helpful preventative measures.

KEYWORDS Cannabis; pediatric; edibles

anemanich@gmail.com

NACCT 2022 - Presenter Index

NACCT 2022 - Keyword Index, by abstract number