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1. Exploration of the binding of hydroxocobalamin with sulfur containing compounds

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Background: Hydrogen sulfide and methanethiol are toxic chemicals recognized by the US Environmental Protection Agency, Occupational Health and Safety Administration, Department of Defense, and the Department of Homeland Security. Currently, there is no FDA approved antidote for the treatment of hydrogen sulfide and methanethiol. Previous studies have explored the use of cobalt containing compounds, hydroxocobalamin and cobinamide. There are several proposed mechanisms of action of cobalt containing compounds for treatment of hydrogen sulfide and methanethiol toxicity. One proposed mechanism of action mirrors that of the treatment of cyanide toxicity with these compounds in that the potential antidote is thought to complex with hydrogen sulfide and methanethiol, or one of its metabolites, directly. Elucidating the mechanism of action will complement in vivo studies testing the efficacy of these compounds for potential use as countermeasures for certain toxins. To assess the mechanism of action, we designed an in vitro study.
Methods: Hydroxocobalamin (HOC): In a 250mL Erlenmeyer flask equipped with a stir bar, 100 milligrams of hydroxocobalamin was dissolved in 200mL of water. Dilute sodium hydroxide was added to the solution, to adjust to physiologic pH (7.0-7.5). To this solution, an equimolar amount of either sodium hydrogen sulfide (SHS) or sodium thiomethoxide (STM) was added under a fume hood, placed on a stir plate and mixed. At 30 minutes, a sample was taken from the solution and analyzed via LC/MS to detect if sulfur complexed with hydroxocobalamin and if so, in what molar ratio. Aquohydroxycobinamide (AHC): In a 20mL scintillation, vial equipped with a stir bar, 70-100 milligrams of aquohydroxycobinamide was dissolved in 5mL of water. To this solution, a solution containing a precise amount of either SHS or STM was added under a fume hood. The volume of the solution addition was determined to afford the addition of a full equivalent of thiol over 30 minutes. The system was placed on a stir plate and mixed. At 10-minute intervals, a sample was taken from the solution and analyzed via LC/MS to detect if the sulfur complexed with aquohydroxycobinamide and if so, in what molar ratio.
Results: Reaction with a single equivalent of SHS consumed 50.9% of HOC after 30 minutes. Analysis at 330 minutes showed no significant further reaction occurred (13.092 μg/mL to 12.952 μg/mL). This seems to indicate that HOC is capable of reacting with two equivalents of SHS. The reaction of a single equivalent of SHS resulted in 44.0% consumption of AHC. Addition of a second equivalent of SHS consumed 89.0% of the starting AHC. The reaction of AHC with one equivalent of STM resulted in area count of AHC decreasing by 39.8% after 30 minutes. Addition of a second equivalent of STM consumed 57.7% of the starting AHC.
Conclusions: The intent of this experiment was to establish that thiols react with the cobalt complexed inside a porphyrin ring, such as hydroxocobalamin or aquohydroxycobinamide, and the stoichiometry of the reaction. In the case of HOC, only the reaction with equimolar SHS gave a clear indication that a reaction had occurred and only one-half of the HOC had been converted. The reactions using AHC and either SHS or STM proceeded to 40-44% conversion.

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2. Glycolic acid exacerbates analytical performance of lactate assay

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Background: The diagnosis of ethylene glycol poisoning can be challenging due to the limited availability of routine testing. The toxic metabolite of ethylene glycol (glycolic acid) is known to falsely elevate lactate levels. Several published reports have demonstrated the effect of glycolic acid on lactate assays on different platforms used in clinical labs. The knowledge gap of the concentrations of glycolic acid that results in significant interference with these platforms is not well studied. A difference in the measured lactate on two platforms, or lactate gap, has been suggested as another screening modality to expedite treatment in case of Eg poisoning. Earlier studies have shown a significant amount of lactate gap between the platforms used in institutions. However, the concentration at which the lactate gap is significant between Radiometer ABL 800, Beckman AU 480, Roche Cobas c502, and i-STAT platforms was unknown. The principles and enzymes used by the platforms are spectrophotometry using a lactate dehydrogenase (LDH) method (Radiometer ABL 800); photometrically using lactate oxidase and peroxidase method (Beckman AU480); colorimetrically using specific enzyme lactate oxidase and peroxidase (Roche Cobas c502); amperometrically using lactate oxidase immobilized on a biosensor (Abbott i-STAT). Herein, the purpose of this study was to evaluate the dose-response effect of glycolic acid on lactate assay platforms in the clinical labs. A secondary objective was to determine if the sufficient lactate gap might be a useful tool for evaluating possible ethylene glycol poisoning.

Methods: This study has been reviewed by the Institutional Review Board (IRB) and it has been determined that it is exempt from IRB review. Herein, we tested the effect of different concentrations of glycolic acid (0.01-46mM) on the lactate assay by using central lab and the point of care (POCT) analyzers Radiometer ABL 800, Beckman AU480, Roche Cobas c502, Abbott i-STAT. Furthermore, we compared the significant bias in the samples in the spiked versus unspiked serum samples on all the quantitative platforms.
Results: Measurement of lactate with increasing concentrations of glycolic acid on Beckmann AU480 did not show any significant bias. However, Radiometer ABL 800, Roche Cobas c 502, and i-STAT platforms resulted in false-positive lactate results. Glycolic acid at a concentration of 0.007-0.03mM (0.55-2.2 ug/mL) resulted in <10% bias on all the four platforms. Glycolic acid concentration ≥0.06 mM (4.4ug/mL) resulted in >10% positive bias on Radiometer ABL 800 and concentration ≥0.12 mM (8.8ug/mL) resulted in >10% positive bias on both Abbott I-stat and Roche Cobas 502. Also, it is noteworthy that at concentrations ≥0.06mM, we see a much-pronounced lactate gap between ABL 800 and both Roche Cobas c 502 & i-STAT. Further, the lactate gap between i-STAT and Roche Cobas 502 increases at concentration ≥0.46Mm(35ug/mL).
Conclusion: Our data in entirety suggest that minute concentrations of glycolic acid resulted in significant bias which could result in misdiagnosis. Our results demonstrate a positive bias from glycolic acid that becomes more pronounced at increasing glycolate concentration and would result in an increasing lactate gap between platforms. Falsely elevated lactate levels could result in misdiagnosis if the clinicians are unaware of interference.

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3. The diagnostic value of D-dimer in australian snake envenoming (ASP-29)

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Objective: The early identification of snakebite patients with systemic envenoming is essential for early antivenom treatment, including early detection of venom induced consumption coagulopathy (VICC). We investigated the diagnostic accuracy of D-dimer for detection of VICC and complications.
Methods: We reviewed all patients from the prospective Australian Snakebite Project (ASP;2005-2018), in which a quantitative D-dimer was measured. Bite time, clinical effects and laboratory investigations were extracted. Cases were classified as non-envenomed snakebites (normal controls), envenomed without VICC, envenomed with VICC and VICC with thrombotic microangiopathy or acute kidney injury based on defined clinical and laboratory criteria. The predictive performance of a quantitative D-dimer in diagnosing envenoming, with and without VICC was tested using area under the receiver-operating-characteristic curve (ROC-AUC).
Results: There were 1316 snakebites: 761 envenomed patients, 562 with VICC and 199 with envenoming but no VICC. 1029 patients had a D-dimer available within 6h post-bite. Plots of the median D-Dimer versus time showed that 95% of patients with VICC had a D-Dimer >4mg/L by 4h post-bite and 95% of non-envenomed patients had a D-dimer <2mg/L during the first 6h post-bite. A D-dimer within 6h post-bite predicted VICC with an AUC-ROC, 0.96 (95%CI:0.94-0.97), and a cut-point of 1.5mg/L gives a sensitivity of 89% and specificity of 98%. In patients with normal coagulation studies, a D-dimer within 6h post-bite predicted VICC with an AUC-ROC, 0.98 (95%CI:0.96-1.00;cut-point 1.4mg/L: sensitivity 89%, specificity 98%). All patients with thrombotic microangiopathy or acute kidney injury had a D-Dimer >4mg/L after 3h, except two patients who only had a D-dimer within 2h.
Conclusion: Our study supports an early quantitative D-Dimer for diagnosis of VICC in snakebite patients, optimally 2-4h for it to be diagnostic and sufficiently early for antivenom administration within 6h. A D-dimer <4mg/L at 6h excluded snake-bite associated thrombotic microangiopathy and acute kidney injury, complications of VICC.

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4. Characterization of F(ab')2 and Fab crotalidae antivenom single and combination therapy 2018-2020: retrospective analysis of the North American Snakebite Registry

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Background: Equine $F(ab')_2$ crotalidae antivenom became available in the United States in late 2018. Previous studies have evaluated this $F(ab')_2$ therapy in comparison to ovine Fab crotalidae antivenom as single agents, but the utilization of combination antivenom therapy is not well described. This study investigates the utilization and effectiveness of this combination of antivenoms for rattlesnake envenomation in comparison to single agent therapy.
Methods: Hospital visits for identified rattlesnake envenomations with complete data were extracted from the 2018-2020 Toxicology Investigators Consortium North American Snake Bite Registry. Data were divided into four therapy groups: Fab-only, $F(ab')_2$-only, Fab-first, and $F(ab')_2$-first. Descriptive statistics were utilized, and comparisons performed with chi-squared, t-test or Wilcoxon tests when appropriate. Dosing equivalents (DE) are recorded as a 10:5 vial correction for $F(ab')_2$ and Fab antivenoms.
Results: The registry contained 279 patients given antivenom. Fab-only therapy occurred in 100%, 43.6%, and 27.5% of cases in 2018, 2019, and 2020, respectively. Only 4 states utilized $F(ab')_2$ (AZ, NM, CO, CA). Combination therapy accounted for 30.9% and 32.5% of 2019 and 2020 cases. Only 6 cases of $F(ab')_2$-first combination therapy were identified and 3 had early adverse reactions. 159 Fab-only, 60 $F(ab')_2$-only, and 54 Fab-first cases were identified with median (IQR) durations of antivenom therapy 14.5 (0-26), 6.9 (0-17.3), and 16.1 (8.7-23.1) hours, respectively. The duration of $F(ab')_2$-only therapy was significantly shorter than either Fab-first ($p < 0.01$) or Fab-only ($p < 0.03$) with 38 patients getting maintenance dosing in the Fab-only group. Hospitalization was less than 48 hours in 69.9% of patients but this was not significantly different between groups. Signs of post-hospitalization serum sickness occurred in 3.2% of Fab-only, 6.7% $F(ab')_2$-only, and were not recorded in Fab-first. Post-hospitalization antivenom was given in 5 cases, all in the Fab-only group. Rehospitalization occurred in 3.1% of Fab-only, 3.3% of $F(ab')_2$-only, and 7.4% of Fab-first. Median DE (IQR) required for initial hospitalization were 2.4 (1.2-3.6) Fab-only, 1.8 (1-2.5)

$F(ab')_2$-only, 2.8 (2.2-3.8) Fab-first. Adverse reactions occurred in 13.0% of Fab-first cases vs 2.5% of Fab-only and 3.33% $F(ab')_2$ only ($p < 0.01$). Outside hospital transfers were reported in 72.2% of the Fab-first group vs 37.7% Fab-only ($p < 0.01$), and 61.7% $F(ab')_2$-only. Late thrombocytopenia (platelets <120 K/mm^3) was recorded in 22% of Fab-only vs 3.3% of $F(ab')_2$-only ($p < 0.001$) and 9.3% of Fab-first ($p < 0.05$). Late coagulopathy (prothrombin time >15 sec) and hypofibrinogenemia (fibrinogen <170 mg/dL)) were present more frequently in Fab-only therapy than both other groups.

Conclusion: In the 2018-2020 North American Snake Bite Registry combination therapy with $F(ab')_2$ and Fab was more likely associated with early adverse events and outside hospital transfers though characterization was limited by the rarity of $F(ab')_2$-first therapy. $F(ab')_2$-only therapy was associated with fewer dose equivalents, and shorter duration of antivenom therapy. No significant differences were detected in the rate of hospitalization under 48 hours. Fab-only therapy was more closely associated with antivenom required at follow up, late thrombocytopenia, coagulopathy, and hypofibrinogenemia.

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5. In vitro analysis of N-acetylcysteine (NAC) interference with the international normalized ratio (INR)

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Background: Previous literature suggests a laboratory interference of n-acetylcysteine (NAC) with prothrombin time (PT) and the international normalized ratio (INR). Early publications focused on this interaction in the setting of an acetaminophen overdose and evaluated the INR of patients receiving intravenous NAC. However, there is limited literature describing the concentration-effect relationship of NAC to INR measurement in the absence of acetaminophen-induced hepatotoxicity at therapeutic NAC concentrations. The purpose of the study is to quantify the degree of interference of NAC on INR values at therapeutic concentrations correlating to each infusion of the regimen (ex. bag 1: 550 mcg/mL, bag 2: 200 mcg/mL, bag 3: 35 mcg/mL, double bag 3: 70 mcg/mL) and at supratherapeutic concentrations in vitro.

Methods: Blood samples were obtained from 11 volunteer subjects. Each blood sample was transferred into vials containing 0.3 mL buffered sodium citrate 3.2% and spiked with various concentrations of NAC for final concentrations of 0, 35, 70, 200, 550, 1000, 2000, and 4000 mcg/mL. The samples were centrifuged and tested to determine PT and INR on two separate machines: Siemens CS-2500 and Stago SN1114559. We would require a sample size of 6 to achieve a power of 80% and a level of significance of 1.7% (two-sided), for detecting a mean difference of 0.4 between pairs, assuming the standard deviation of the differences to be 0.2. Differences between INRs at varying concentrations were determined by a one-way ANOVA with multiple comparisons. Analyses were performed using GraphPad Prism 9.0.0.

Results: Participants included 11 healthy subjects: 8 males, 3 females, median age 30 years (range 25–58). Mean and standard deviation INR for the control samples were 1.10 ± 0.09 for Siemens and 1.00 ± 0.07 for Stago analyzers. There was no clinically significant difference noted for any of the therapeutic concentrations (35, 70, 200, or 550 mcg/mL). The largest INR increase seen was in one patient from a baseline of 1.07 to 1.32 in for the 550 mcg/mL concentration. Increases in concentrations to supraphysiologic levels resulted in a non-linear increase in INR. There was a statistically significant increase in INR at 2000 mcg/mL for the Stago analyzer ($p = 0.030$) and at 4000 mcg/mL for both analyzers ($p < 0.0001$).

Conclusion: At therapeutic concentrations, the in vitro interference of NAC appears to not affect INR measurement.

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6. New insights on acetaminophen half-life using multisource pharmacokinetic data

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Background: The elimination half-life of acetaminophen (APAP) is believed to increase in APAP overdose as well as in states of hepatic dysfunction. The most robust previous APAP half-life analysis was limited to 2 large datasets containing exclusively overdose data, bringing into question the generalizability of the findings. We expand upon prior work by utilizing a large, multisource pharmacokinetic (PK) dataset that combines data from overdose cases with intensively sampled PK data from randomized controlled trials (RCTs) to better characterize APAP half-life predictors.

Methods: We examined 21,848 APAP concentrations from 6,657 cases admitted to hospital or participating in RCTs comparing APAP preparations or supratherapeutic doses. We initially selected cases with 3 or more measured [APAP] and excluded last concentrations which were below the level of quantitation (BLQ) which left 3,952 cases. We carried out 8,443 linear regressions, beginning with the last 3 levels and iteratively repeating out to the last 20 levels. We then selected the best linear regression for each of the 3,952 cases. Of these, 2,466 cases had best regression p-value <0.05 and comprised our PK dataset. Outcome measures included max aminotransferases (AST, ALT), max INR, and max bilirubin. Data which were log-normally distributed were log transformed. Predictors of half-life were selected by stepwise multiple regression with p-value thresholds of 0.1 to enter and 0.05 to leave. R-squared, the fraction of the half-life variability described by the model (rsqr) was reported. LogWorth and Pvalue were used to assess the statistical contribution of each predictor. All data handling and analyses were via SAS JMP 16.0.1.

Results: Acceptable PK data were available in 18 studies, including 15 overdose studies and 3 RCTs. The analysis dataset included 11,308 [APAP] from 2,466 cases (2,369 from overdose studies, and 97 from RCTs). The RCT population yielded 840 [APAP], averaging over 8 [APAP]per case. Median [min,max] APAP half-life was 3.7 [1.09, 62.17] hours, 7 patients received liver transplantation and there were 14 deaths. Only 554 cases were included in the multivariate model as outcome measures were not universally available. The best multivariate model for half-life prediction included peak aminotransferases, [APAP], and [bilirubin] ($n = 554$, rsqr $= 0.46$, $p < 0.0001$). Patient historical data, including age, and presence or absence of co-ingestions contributed relatively less or not at all to the final model.

Conclusions: The incorporation of robust APAP PK data from additional overdose and RCT settings expands upon our ability to predict APAP half-life. Consistent with prior studies, historical data such as demographics, pre-existing medical conditions or quantity of ingestion were either minor contributors or non-contributory to half-life prediction. Outcome data along with the peak APAP concentration remain central in predicting half-life. However, our analysis found INR to be a less significant predictor than previously described, while transaminases and bilirubin were comparatively greater contributors. This broadened and inclusive population PK study improves our understanding of the physiologic contributors governing APAP half-life and may ultimately allow for early prediction of outcome in the future

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7. Evaluation of N-acetylcysteine dose for the treatment of massive acetaminophen ingestion

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Background: The use of N-acetylcysteine (NAC) remains the standard of care for treatment of acetaminophen (APAP) toxicity and overdose. Currently, there is growing evidence to suggest that massive acetaminophen overdose is associated with increased hepatotoxicity despite timely administration of NAC. This raises the question as to whether an increased dose of intravenous (IV) NAC should be used in the setting of massive APAP ingestion. This study aimed to evaluate the rate of hepatotoxicity after massive APAP overdose treated with 3 different NAC treatment regimens.
Methods: This was a retrospective cohort study conducted by electronic medical record chart review of cases reported to a statewide poison control system between 2007 and 2020. Inclusion criteria: Single substance APAP or APAP combo agent ingestion; acute massive APAP ingestion (defined as APAP concentration at least 2 times the Rumack-Matthew 150 nomogram); received one of the three NAC regimens: standard dose IV NAC, standard dose oral (PO) NAC, or high dose IV NAC (150 mg/kg IV loading dose followed by 50 mg/kg infusion over 4 hours followed by 200 mg/kg infusion over 16 hours). Exclusion criteria: multi-substance ingestions; unknown time of ingestion; AST/ALT not recorded; chronic or staggered ingestions; received both IV and PO NAC, AST/ALT >1000 U/L prior to treatment, presentation to the emergency department >24 hours post ingestion. Data collected: age, sex, APAP product (APAP alone vs. combination product), time since ingestion, APAP concentration, initial AST/ALT, whether NAC was started within 8 hours post ingestion, whether hepatotoxicity developed (defined as AST/ALT >1000 U/L), and medical outcome. An APAP ratio was determined to standardize the APAP concentration for different times by dividing the concentration by the corresponding value on the Rumack-Matthew 150 nomogram line. ANOVA was used for normally distributed continuous variables, Kruskal-Wallis test for non-normally distributed variables, and chi-square for categorical variables. The risk of hepatotoxicity was evaluated using multivariate logistic regression model with standard dose IV NAC as the base variable for comparison between dosing regimens.
Results: A total of 373 patients met inclusion for the study. Of those, 135 cases were treated with standard dose IV NAC, 121 cases treated with PO NAC, and 117 cases treated with high dose IV NAC. The risk of developing hepatotoxicity was not statistically significant between the high dose IV NAC (OR 1.05, 95% CI 0.52 – 2.09) or oral NAC (OR 0.69, 95% CI 0.33 – 1.46) when compared to standard dose IV NAC. When adjusted for APAP products, APAP ratio, initial elevated AST/ALT, and treatment within 8 hours, there remained no difference in treatment regimens and risk of developing hepatotoxicity.
Conclusion: This is the first study to compare all three NAC regimens in the setting of acute massive acetaminophen ingestion. Our findings suggest that high dose IV NAC does not decrease the odds of developing hepatoxicity in this patient population.

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8. Outbreak of hepatitis of unknown etiology associated with bottled alkaline water ingestion

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Background: Liver injury can have numerous etiologies. Toxicological causes are often considered after infectious, autoimmune, metabolic, and genetic causes have been eliminated. There have been multiple prior outbreaks of toxic hepatitis, though not all of them have had a causative agent identified. We present a cluster of suspected toxic hepatitis cases among patients with exposure to a commercially available alkaline water product.
Cases: During 11/23/2020 to 12/4/2020, a regional health department was notified of five cases of severe acute hepatitis of unknown etiology in patients aged 7 months to 5 years. These initial patients presented with complaints of vomiting, poor oral intake, and fatigue. Clinical investigation noted elevated hepatic transaminases, hyperbilirubinemia, and coagulopathy. All patients were transferred to a pediatric liver transplant center. Despite extensive workup no cause was identified. During hospitalization the patients received antibiotics (5/5), antivirals (5/5), vitamin K (5/5), cryoprecipitate (3/5), fresh frozen plasma (3/5), and n-acetylcysteine (1/5). One patient required intubation due to encephalopathy and need for airway protection. Two patients underwent liver biopsy; both showed non-specific hepatocyte ballooning without necrosis, while one biopsy also showed marked macrovesicular steatosis and mild eosinophilia. All patients showed rapid clinical and biomarker recovery (mean 13.4 days from onset of symptoms to hospital discharge). Review of medical records and further exposure history obtained by the regional health department revealed that all case patients ingested a specific brand of commercially sold alkaline water. The mean time from first consumption to symptom onset was 9.4 months; all patients consumed the product up to the time of symptom onset. No other common exposures or epidemiologic linkages were identified.
Discussion: Thus far, a public health investigation identified 11 probable cases of severe new-onset hepatitis of unknown etiology as of 5/11/2021 (patients aged 7 months – 71 years), including the initial patients. Medical record review showed most cases presented with non-specific symptoms; a minority of cases

also showed clinical evidence of hepatic injury, including jaundice and altered mental status.) Laboratory results showed evidence of marked liver injury with hepatocellular predominance, often with severe coagulopathy. A third biopsy from an adult patient showed a pattern of macro and microvesicular steatosis. All currently identified probable case patients recovered without requiring liver transplant. Current data raises concern for a hepatotoxin that can cause variable findings on biopsy; however, the multi-agency investigation is ongoing and an identifiable causative agent has yet to be discovered as of 5/11/2021. Currently, the manufacturer has recalled the product and the investigation continues, seeking to identify additional cases and a potential agent or contaminant.
Conclusions: The identified common source of alkaline water exposure, rapid recovery after removal of that exposure, and lack of other identified cause despite broad and thorough workup strongly suggests an exposure to an as-of-yet unidentified hepatotoxin. These cases demonstrate the importance of an exposure history and the need for a high index of suspicion for toxicologic causes of liver injury.

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9. Validity and reliability of the poisoning severity score in a pediatric poisoned population

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Background: Hospital management of a poisoned child involves a systematic assessment of the severity of the child's condition. Recently, the *Poisoning Severity Score* (PSS) was developed to evaluate the severity of poisoning. However, this tool is insufficiently validated in children where the generic *Pediatric Logistic Organ Dysfunction Score* (PELODS) is preferred. We aimed to assess the predictive validity and reliability of the PSS in measuring the severity and progression of the intoxication in children as compared to the PELODS.
Methods: We conducted a multicenter retrospective cohort study using retrospective data collected from health records of hospitalizations between 2013 and 2016 at three health care facilities in our Canadian province. All poisoned children aged 0 to 17 years old were included if managed in the emergency department (ED) within 12 hours of ingestion of a potentially toxic dose of an activated charcoal-adsorbable substance. The PSS and PELOD scores were measured on arrival at the ED and again 12 hours later. Logistic regression was used to estimate the discriminatory ability of the initial PSS and the 12-hour delta PSS to predict admission, intensive care unit (ICU) hospitalization, hospital length of stay $\geq$12 hours, and the need for follow-up after discharge. Inter-rater reliability of the PSS was measured using weighted Kappa coefficients.
Results: Of the 469 subjects included in the study, 140 (30%) were admitted to the hospital, including 109 (23%) in the intensive care unit (ICU). One hundred eighty-nine (40.3%) were hospitalized 12 hours or more, and 83 (18%) were discharged to a psychiatric facility or with a follow-up in psychiatry. An initial PSS of 0 was observed for 97% of non-hospitalized subjects versus 58% of admitted subjects ($p < 0.05$). The areas under the receiving operating characteristics curves (AUC) for the initial PSS and the 12-hour delta PSS were respectively 0.690 (95% confidence interval (CI) 0.649-0.732) and 0.626 (95% CI 0.581-0.670) for hospital admission; 0.649 (95%CI 0.601-0.697) and 0.604 (95% CI 0.555-0.652) for ICU admission; 0.666 (95% CI 0.632-0.700) and 0.609 (95% CI 0.572-0.645) for a hospital length of stay $\geq$12 hours; and 0.569 (95% CI 0.519-0.620) and 0.529 (95% CI 0.477-0.582) for follow-up after discharge. The AUC of the PSS was significantly higher than the PELODS ($p < 0.0001$) for all outcomes. Inter-rater reliability was good for the initial PSS and moderate for the 12-hour PSS with weighted Kappa coefficients of 82% and 77%, respectively.
Conclusions: For children aged 0 to 17 years old presenting to the ED within 12 hours of ingestion of a potentially toxic dose of an activated charcoal-adsorbable substance, PSS seems to be a better prognostic tool than PELODS for measuring the severity and progression of the intoxication, with good inter-rater reliability. However, its discrimination performances remain poor.

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10. Pediatric suicides reported to the US poison centers

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Background: Suicide rates in adolescents and young adults have been significantly increasing over recent years, with suspected suicide cases by intentional ingestion more than doubling in many regions. The rise in adolescent cases of self-poisoning has led to increases in serious medical outcomes in this population, emphasizing the necessity of addressing the current pediatric mental health crisis.
Methods: The National Poison Data System (NPDS) was queried for all suspected pediatric suicides from 2015 to 2020. We identified and descriptively assessed the relevant demographic and clinical characteristics. Trends in frequencies and rates (per 100,000 human exposures) were analyzed using Poisson regression methods, stratified by study characteristics. Percent changes from the first year of the study (2015) were reported with the corresponding 95% confidence intervals (95% CI).
Results: There were 514,350 suspected suicides among children ages 6 to 19 years reported to the poison centers (PCs) from 2015 to 2020, with the rate of such calls increasing by 26.7% during the study period (95% CI: 21.2%, 32.5%, $p = 0.002$). Single substance exposures accounted for 67.7% of the calls. Demographically, 77.9% of cases were females, with the rate of suspected suicides among females increasing by 26.6% (95% CI: 20.4%, 33.2%, $p < 0.001$). The largest rate of increase in suspected suicides among children occurred in the ages between 10 and 12 years (109.3%, 95% CI: 71.6%, 155.3%, $p = 0.002$). Significant increases were also seen in the 13 to 15 year age range (30.3%) and the 16 to 19 year age range (18.1%). Major effects were seen in 2.9% of cases with the rate increasing by 69.2% (95% CI: 29.8%, 96.7%, $p < 0.001$). There were 276 deaths during the study period. The three most common substances reported were ibuprofen (14.9%), acetaminophen (11.2%), and atypical antipsychotics (7.5%). The largest increase in rate of exposures (70.7%) was seen for acetaminophen during the study period (95% CI: 49.5%, 94.9%, $p < 0.001$).
Conclusions: In this study, the overall rate and frequency of human poisoning exposures attributed to suicide attempts significantly increased among children ages 6 to 19 years. These numbers highly suggest that cases of suicidal ideation are continuing to rise and are extending into younger populations. The NPDS is dependent on voluntary reporting and the data underrepresents the actual number of suspected suicide attempts by intentional ingestion. Pediatric populations have easier access to over-the-counter medications, potentially explaining the large

increase seen in attempted suicides utilizing ibuprofen and acetaminophen. The largest rate of increases in exposures attributed to suspected suicide cases occurred in children ages 10 to 12 years, however increases occurred in even the youngest population analyzed (ages 6 to 9 years). This data demonstrates significant rises in cases of self-poisoning among all pediatric age groups, suggesting that the pediatric mental health crisis is worsening. To our knowledge this is the first study revealing such significant increases in suspected suicide cases trending into the younger pediatric populations. Appropriate mental health screenings and interventions need to be initiated in these young age groups in order to prevent further rises in suicide rates.

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11. Poison center patients: reduced mortality, hospital length of stay, and charges: findings from a linked database

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Background: Demonstrating the benefits of poison center (PC) consultation is challenging. We linked a statewide hospital billing database with PC cases to assess the impact on patient mortality, length of stay, and hospital charges.
Methods: Hawaii Poison Center (HPC) data were deterministically linked to hospital data using personal identifiers, demographic and temporal data over 2013 to 2016. We used diagnoses from the 2012 *Consensus recommendations for national and state poisoning surveillance,* Injury Surveillance Workgroup 7. Adverse reactions were excluded. The final sample contained 10,542 records, including 3,086 HPC linked cases. Analyses compared patient demographics, length of hospital stay, charges, and hospital outcomes. Multivariate logistic regression estimated relative odds of death in hospital, or death combined with discharge to hospice, after adjustment for covariates.
Results: Although 90% of the 3,086 HPC exposures occurred in patients' "own residence", most (86%) HPC contacts originated in a "health care facility". The average age of HPC patients was significantly lower than non-HPC patients. Two-thirds (66%) were under 35 years of age, compared to 40% of the latter. HPC patients were more likely to be female, present to the more rural-based hospitals in Hawaii, Kauai, and Maui counties, and have Medicaid or other income-qualifying insurance. HPC patients were significantly less likely to have multiple presentations for acute drug poisoning over the study period (23.4% vs. 27.5% of non-HPC patients). Non-HPC patients were more likely to be discharged from the emergency department (61.2% vs. 55.7% of HPC patients), but were also significantly more likely to die (1.0% vs. 0.4%) or to die or be discharged to hospice (1.4% vs. 0.6%), compared to HPC patients.
Results: Approximately one-third of HPC patients were hospitalized for one day, compared to 27% of the non-HPC patients. Non-HPC patients were significantly more likely to be hospitalized for a week or more. On average, HPC patient hospital charges were $8,000 less than non-HPC patients, and significantly less likely to be in the highest quartile ($28,000 or higher), compared to non-HPC patients (19%, vs. 28%, respectively). Odds of death were significantly lower, by 48%, among HPC patients, in multivariate analysis controlling for age group, gender, level of care and multiple presentations. Results were similar for death or discharge to hospice, with a 43% odds reduction among HPC patients compared to non-HPC patients.
Conclusions: HPC consultation was independently associated with significantly lower odds of death. HPC patients also had shorter hospital stays and incurred lower total charges. While the financial findings among admitted patients were statistically robust, the reduction in mortality was of narrow statistical significance, perhaps due to the relatively low number of deaths over the 4-year study period. Despite this caution, we believe this is one of the few studies to directly associate patient benefits with poison center intervention. The availability of the poison center increases access to specialty consultation, decreasing health care inequities regardless of demographics or location.

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12. Poison center utilization decreases emergency healthcare costs

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Objectives: The objective of this study was to extrapolate survey results submitted by individuals who called Pennsylvania poison centers to calculate estimated emergency healthcare cost avoidance, reflected by charges, attributable to Pennsylvania poison centers.
Methods: An online survey was e-mailed to callers who contacted one Pennsylvania poison center with an exposure-related question and did not require emergency treatment at a healthcare facility. Participants were asked what they would have done had there not been a poison center. Results were extrapolated to all Pennsylvania poison control center calls that did not require healthcare facility management. Estimated healthcare cost avoidance was calculated by multiplying published charge estimates by the number of callers who would have chosen each alternative.[1] If the chosen alternative required additional healthcare costs, those were factored in as cost avoidances (e.g. a primary care physician refers a patient to the emergency department) based on available literature.[2,3] Individual costs were totaled to calculate a single dollar amount of charge avoidance.
Results: Between February 2016 and December 2020, 2,446 surveys were completed from surveys sent to 14,062 e-mail addresses, for a response rate of 17.4%. Without access to a poison center, the top alternatives callers would have chosen were: contact their primary care physician (42%), go to the emergency department (17%), call 911 (9%), or go to urgent care (6%). Additionally, 17% of callers stated they would do an internet search and 6% would wait for worsening of symptoms. In 2020, Pennsylvania poison centers received 62,829 exposure calls that were not managed at a healthcare facility. Extrapolating the data from the survey and other publications to the calls received in 2020, the estimated healthcare charges avoided by poison center utilization totaled $62,724,700.
Conclusions: Based upon published data of healthcare utilization and charges, as well as surveys of more than 2,400 individuals who called a Pennsylvania poison center, the estimated annual savings in healthcare charges attributable to Pennsylvania poison centers is over $62 million. These data do not include the 23% of callers who stated they would wait for symptoms to worsen or perform an internet search for information, which can lead to delays in care or accessing inaccurate information. This estimate does not include reductions in hospital lengths of stay, increased efficiency, and quality of care that centers provide.[5] The survey used did have a low response rate compared to some industry standards, though efforts were made to improve response rates.[4] Poison center services are responsible for significant cost

avoidance by preventing unnecessary emergency healthcare utilization for non-toxic or minor poisonings.

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13. Transdermal buprenorphine for in-hospital transition from full agonist opioids to sublingual buprenorphine: a retrospective case series

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Background: Initiation of treatment with sublingual buprenorphine (SL BUP) requires a period of opioid withdrawal due to the risk of precipitated withdrawal if administered too early. This is a significant barrier to treatment in patients who either cannot tolerate the withdrawal period or have significant pain. Traditional "micro-dosing" of SL BUP may not be feasible in the inpatient environment due to pharmacy and nursing regulations involving controlled substances. A few investigators have reported the use of transdermal buprenorphine (TD BUP) to bridge patients from full agonist opioids to SL BUP without a withdrawal period.
Case series: This is a series of 40 unique patients (representing 41 total cases) who were transitioned from full agonist opioids to SL BUP using a protocol incorporating TD BUP. Thirty-five cases were transitioned from opioids administered by clinicians during their hospitalization; of these, 8 were receiving methadone prior to the transition. Six cases were transitioned from illicit opioids used prior to hospital presentation. For patients receiving prescribed opioids in the hospital, the median MME on the day prior to TD BUP placement was 63.8 (range 0-900, IQR 153.8); the median MME on the day of TD BUP placement was 34.5 (range 0-600, IQR 65.3). In other words, patients could continue to receive full agonists while being induced on SL BUP with a transdermal patch. In 38 cases, the transition occurred successfully; nearly all patients tolerated this well without significant withdrawal and remained on buprenorphine through their hospitalization. In two cases, the patients refused further doses of SL BUP after their first, and in one case, the patient opted to switch to methadone instead of SL BUP shortly after the transition period. In general, patients tolerated the transition well.
Discussion: Our series, the largest yet reported, is consistent with prior small series and reports that demonstrate the utility of TD BUP in transitioning patients from full agonist opioids to SL BUP during inpatient hospitalization. Patients on large total opioid doses, including several patients on methadone, were able to transition successfully to SL BUP using our TD BUP protocol without significant withdrawal symptoms.
Conclusions: TD BUP is a valuable tool to assist in SL BUP induction in inpatients who are receiving opioids for medical purposes or who recently used illicit opioids. Increased utilization of this strategy would decrease one barrier to buprenorphine induction in hospitalized patients.

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14. False negatives in urine drug screening to inform directed expansion of screening, brief intervention, and referral to treatment in trauma patients

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Background: Relying on urine drug screen (UDS) immunoassay results to screen for substance use in traumatically injured patients underestimates their rate of problematic substance use since many substances are not detectable by UDS. The objective of this study 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 trauma patients.
Methods: We performed a prospective cohort pilot 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 testing and LC-MS comprehensive testing of >200 analytes. Patients who did not provide urine samples while in the Emergency Department were excluded. Iatrogenic medications given by the treating team were documented and excluded from the total FN count. Crosstab analyses were conducted for UDS versus LC-MS outcomes to establish the types and rates of FN results. We further dichotomized the results by creating a variable for "intentionality" (intentional injuries by self or others versus accidental injuries). A series of crosstabs with crude odds ratios was conducted which considered intentionality by substance class and demographics. Variables found statistically significant by Chi-Square were submitted to logistic regression.
Results: 100 urine samples meeting inclusion criteria were analyzed Psychoactive FNs were detected in 56/100 samples, with the most frequent non-iatrogenic psychoactive substance classes including anticonvulsants (primarily gabapentin, N = 13), pharmaceutical opioid agonists (N = 12), antihistamines (primarily diphenhydramine, N = 10), and phenethylamines (primarily bupropion, N = 5). Nonpsychoactive FNs were detected in 70/100 samples, with the most common being nicotine (N = 33), caffeine (N = 23), acetaminophen (N = 22), and antidepressants (N = 12). Of eight primary substance classes included in the UDS and also tested by LC-MS, FNs occurred for opiates (3%), amphetamines (5%) and opioids (25%). When considered for intentionality, cocaine ($p = 0.015$) and cannabinoids ($p = 0.002$) were found by Chi-Square to be statistically significant. The combination of three variables was 80.4% predictive of intentionality by logistic regression: cannabinoids, amphetamines, and severity of injury. Consistent with previous literature, positive urine testing for cannabinoids was associated with positive urine testing for opioids, but not for benzodiazepines or alcohol.
Conclusions: These data show that UDS testing has a high failure rate for identifying substances that may affect the clinical course and management of trauma patients. American trauma centers are required to screen hospitalized trauma patients for problematic alcohol use, intervene, and refer to treatment in order to reduce recidivism. However, no similar requirement exists for other substance use besides alcohol. Analogous to current efforts to provide screening, brief intervention, and referral to treatment (SBIRT) for trauma patients who misuse alcohol, our results support further extending SBIRT to burn and trauma

patients with problematic use of other substances. These include medications and illicit substances like cannabinoids and amphetamines that were associated with deliberate self-inflicted injury or assault. Expansion of SBIRT appears to be particularly needed for tobacco products, prescription analgesics, and misuse of over-the-counter antihistamines in this patient population.

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15. Characterization of oxycodone misuse using national survey data

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Background: Drug overdoses continues to be a public health crisis with 70,630 U.S. fatalities in 2019. Approximately two-thirds of these deaths (66%) involved a prescription or illicit opioids. Synthetic opioids accounted for 72.9% of opioid-involved overdose deaths in 2019. The objective of the study is to characterize the risk markers of oxycodone misuse using the nationally representative U.S. National Survey of Drug Use and Health (NSDUH) data.
Methods: The 2019 NSDUH public use data were analyzed. The respondents were classified into two groups, past year oxycodone misusers and non-misusers, based on the screening questions. The prevalence of selected demographic, clinical factors and substance use and abuse, including prescription medications, was assessed descriptively for the two population groups using cross tabulated frequencies and chi-square tests. Logistic regression models were used to identify predictors of oxycodone misuse adjusting for covariates. Adjusted odds ratios (OR) and corresponding 95% Confidence Intervals (CI) were calculated
Results: Overall, the 2019 NSDUH survey comprised of 56,136 respondents, of which 4,359 respondents (7.7%) reported using oxycodone products over the last year. Furthermore, 770 respondents reported misuse, accounting for 17.6% of the total oxycodone users or 1.4% of the survey sample. The proportion of past year oxycodone misusers was higher in males (54.1% vs 44.6%, $p < 0.001$), unmarried (69.6% vs 44.8%, $p < 0.001$), and Hispanic (16.3% vs 13.4%, $p < 0.001$). Suicide ideation was much more frequent in oxycodone misusers (19.8% vs 10.1%, $p < 0.001$). The prevalence of use and misuse of other substances in the previous year was significantly higher in the oxycodone misusers. Previous year marijuana use (OR: 1.90, 95% CI: 1.41 – 2.57) was a significant predictor of oxycodone misuse while morphine users were 40% less likely to misuse oxycodone (OR: 0.60, 95% CI: 0.37 – 0.98). Similarly, hydrocodone use reduced the risk of oxycodone misuse by 64% (OR: 0.36, 95% CI: 0.26 – 0.50). Self-reports of obtaining the oxycodone from sources other than the doctors increased the risk of oxycodone misuse by 96% (OR: 1.96, 95% CI: 1.38 – 2.81). Hispanics (OR: 1.34, 95% CI: 1.02 – 1.55) had a significantly higher probability to misuse oxycodone. Oxycodone misuse was significantly more likely among misusers of other opioids including morphine (OR: 5.19, 95% CI: 1.62 – 15.12) and buprenorphine (OR: 2.42, 95% CI: 1.12 – 5.25). Previous year benzodiazepines misusers (OR: 2.44, 95% CI: 1.62 – 3.67), stimulant misusers (OR: 2.68, 95% CI: 1.71 – 4.21) increased the risk for oxycodone misuse in the past year. Males (OR: 1.60, 95% CI: 1.19 – 2.14) and individuals receiving medications for mental health treatment reported a higher risk of oxycodone misuse (OR: 1.46, 95% CI: 1.02 – 2.09).
Conclusions: The current study indicated a high prevalence of oxycodone misuse. Our study highlighted risk factors associated with misuse of oxycodone, including gender and race. Use and misuse of other substances, including other opioids, appear to be important predictors of oxycodone misuse. Tailored interventions and risk-screening measures to optimize oxycodone prescribing may be key in limiting the misuse and diversion of this pain medication.

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16. Use of benzodiazepines in adolescents and young adults: indications, outcomes, and harm-reduction strategies

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Background: Benzodiazepines are frequently used in combination with opioids, and have been implicated in fatal and non-fatal opioid-overdoses including in adolescents and young adults, where misuse in combination with opioids is more likely to result in overdose. This is of particular concern seeing that 2.8% of adolescents and 6.3% of young adults report a prescription for benzodiazepines or tranquilizers between 2015-2016, despite a narrow range of approved indications. In September 2020 the FDA issued a safety communication and revised the Boxed Warning to increase awareness of the serious risks associated with use of this drug class and improve safe prescribing practices. With this in mind, the objectives of this study were as follows:

1. Describe temporal trends in adolescent and young adult benzodiazepine prescribing and overdose
2. Describe polysubstance overdoses involving benzodiazepines
3. Determine rates of appropriate use of benzodiazepines, based on FDA-approved indications
4. Determine rates of co-prescription of opioids and benzodiazepines

Methods: We performed a retrospective cross-sectional analysis of adolescents (13-18 years) and young adults (19-25 years) who received a benzodiazepine prescription or experienced a benzodiazepine overdose between 1/2008 and 12/2019. Prescribing and overdose data was obtained from a large commercial insurance company with over 83 million members, including over 18 million children. FDA-approved benzodiazepine prescribing indications were obtained from Micromedex®; for an individual to have an approved indication for a benzodiazepine prescription, they must have had an approved ICD-9/10 code in the preceding 3-months. ICD-9/10 codes were used to identify benzodiazepine overdoses, as well as polysubstance overdoses including a benzodiazepine and opioid, stimulant, cocaine, and/or alcohol. Descriptive statistics, including frequencies and rates were calculated.
Results: Between 2008 and 2019, 74,539 (17.8 per 1,000 subscribers) adolescents and 246,760 (40.2 per 1,000 subscribers) young adults received at least one benzodiazepine prescription. The prescribing rate for adolescents peaked in 12/2015 at 3.8 per 1,000 subscriber-months and in 8/2013 for young adults at 13.1 per 1,000 subscriber-months. Over the course of the study, only 26.6% of benzodiazepine prescriptions (23.8% adolescent; 27.2% young adult) were linked to an approved indication. 12.5% of all benzodiazepine prescriptions (11.2% adolescent; 12.8% young adult) were co-prescribed with an opioid, although this practice trended down over the course of the study.

There were 1,659 and 3,510 benzodiazepine overdoses in the adolescent and young adult groups, respectively. Overall, 520 (10.1%) benzodiazepine overdoses involved an opioid, 320 (6.2%) involved alcohol, and 137 (2.7%) involved a stimulant Overdose rate peaked in 10/2016 at 4.4 per 100,000 subscriber-months for in adolescents and in 7/2016 at 5.7 per 100,000 subscriber-months in young adults.
Conclusions: Benzodiazepines continue to be prescribed to adolescents and young adults frequently with the vast majority of prescriptions having no documented FDA-approved indication. The co-prescription of benzodiazepines with opioids is common although decreasing. Polysubstance benzodiazepine overdoses occur nearly 20% of the time, with opioids and alcohol being the most frequently encountered co-substances. Additional work is needed to examine the association between harm reduction strategies (e.g., PDMPs) and benzodiazepine overdoses.

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17. Vaccine adverse events among adolescents in the United States

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Background: It is recommended that adolescents receive a variety of vaccinations, such as for influenza, meningococcal disease, and human papillomavirus. However, adverse effects may be experienced after vaccination. The objective of this study is to describe vaccine adverse events among adolescents reported to the United States (US) Food and Drug Administration (FDA).
Methods: Data were obtained from the Vaccine Adverse Reporting System (VAERS), a national database that contains reports of adverse events following vaccination. Reports are classified as serious if one of the following outcomes is reported: death, life threatening illness, hospitalized, prolonged hospitalization, or disability. Cases were all vaccine adverse events with a report received date during 1991-2020 and a vaccination date during 1991-2020 where the AGE_YRS field value range was 13-19. The distribution of cases was determined for selected variables.
Results: A total of 45,953 vaccine adverse events among adolescents were identified. The number of adverse events increased from 256 in 1991 to 4,466 in 2007 then declined to 2,120 in 2019 and 1,483 in 2020. The distribution by season was 8,347 (18.2%) in December-February, 8,991 (19.6%) in March-May, 15,937 (34.7%) in June-August (including 6,716 or 14.6% in August), and 12,678 (27.6%) in September-November. The patient age was 6,416 (14.0%) 13 years, 6,377 (13.9%) 14 years, 6,275 (13.7%) 15 years, 7,174 (15.6%) 16 years, 7,429 (16.2%) 17 years, 7,684 (16.7%) 18 years, and 4,598 (10.0%) 19 years; 29,365 (63.9%) of the patients were female, 14,940 (32.5%) male, and 1,648 (3.6%) unknown sex. The most reported vaccines were 17,522 (38.1%) human papillomavirus, 11,001 (23.9%) meningococcal, 7,641 (16.6%) influenza, 5,313 (11.6%) varicella, 5,129 (11.2%) diphtheria/pertussis/tetanus, and 5,119 (11.1%) hepatitis A. The most reported symptoms were 5,946 (12.9%) dizziness, 5,691 (12.4%) headache, 5,483 (11.9%) pyrexia, 4,507 (9.8%) syncope, 4,364 (9.5%) nausea, 3,284 (7.1%) pain, 3,159 (6.9%) injection site erythema, 3,114 (6.8%) injection site pain, and 2,714 (5.9%) vomiting. An emergency department or doctor visit was reported in 14,516 (31.6%) of the cases. The case was classified as serious in 3,327 (7.2%) of the cases; these included 2,445 (5.3%) where the patient was hospitalized and 119 (0.3%) deaths.
Conclusions: The number of vaccine adverse events among adolescents increased during 1991-2007 and then declined. The reasons for the decline are likely multifactorial, but the recent COVID-19 pandemic may have been a factor on the decline between 2019 and 2020. The highest proportion occurred during the summer, particularly August. Since the new school year in the US typically starts in August or September, this may represent adolescents obtaining required vaccinations before starting school. While almost one-third of the patients visited a doctor or emergency department, few patients were hospitalized. Only a small fraction of the adverse events were classified as serious. Note that a report to VAERS only confirms that the reported adverse event occurred sometime after the vaccine was given and does not prove that the identified vaccine(s) caused the adverse event described. No proof that the event was caused by the vaccine is required in order for VAERS to accept the report.

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18. Treatment of acute aluminum toxicity due to alum bladder irrigation in a dialysis patient

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Background: Acute aluminum toxicity is encountered rarely in clinical practice but carries a high risk of morbidity and mortality. Due to decreased clearance, patients with renal failure have an increased risk for significant central nervous system (CNS) neurotoxicity. While medical advances have reduced chronic aluminum exposure in these patients, they are still at risk for toxicity from acute aluminum exposure, such as alum bladder irrigation.
Case: An 87-year-old man with prostate cancer and end-stage renal disease (ESRD) on hemodialysis was admitted for radiation-induced hemorrhagic cystitis and pneumonia. He underwent bladder irrigation with a solution containing 30 grams of alum (aluminum potassium sulfate) for his bleeding. Approximately 48 hours later he was noted to be acutely encephalopathic. His vital signs and basic laboratory test results were unremarkable. A total blood aluminum concentration (BAC) resulted four days later at 141 mcg/L (reference range: <60 mcg/L for dialysis patients).
Based on the patient's acute mental status change and elevated BAC he received intravenous deferoxamine (DFO) 10 mg/kg over a two-hour period followed by four hours of hemodialysis eight hours after infusion completed. His BAC following the first administration of DFO before dialysis was 537 mcg/L. A concentration obtained shortly after dialysis was 279 mcg/L. This regimen was repeated daily for a total of four infusions and four dialysis sessions. BACs during this treatment period were measured serially; they rose after each DFO infusion and improved after each dialysis session.
On the sixth day after initiating chelation therapy and hemodialysis the patient's mental status was significantly improved despite having a persistently elevated BAC of 249 mcg/L. Based on the patient's clinical improvement he began a schedule of weekly DFO infusions at a lower dose of 5 mg/kg weekly with his routine dialysis schedule. Nine days after beginning chelation therapy the patient was back to his baseline mental status. His blood aluminum concentration at that time was 189 mcg/L.
Discussion: Alum bladder irrigation can cause acute aluminum toxicity in patients with ESRD. This case uniquely documents serial pre- and post-DFO infusion BACs with intercurrent hemodialysis. As the patient's CNS burden ultimately fell below a toxic threshold, with each infusion it appears that aluminum was mobilized into the blood from other compartments. Diligent and efficient removal with dialysis avoids the potential risk of rebound neurotoxicity in these patients. The trajectory of this

patient's chelation therapy unmasked a pattern of persistently elevated BACs despite clinical improvement consistent with acute-on-chronic aluminum exposure.
Conclusion: Alum bladder irrigation in patients with ESRD carries a risk of acute aluminum neurotoxicity. Resolution of neurotoxicity in this patient coincided with conclusion of a rigorous regimen of DFO chelation followed closely by dialysis. Trending BACs during treatment revealed a pattern of increase following DFO suggesting mobilization from tissue compartments and reduction after hemodialysis.

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19. Changes in vaccine adverse event reporting system reports during the COVID-19 pandemic

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Background: Many public health activities changed during the COVID-19 pandemic starting in late 2019. Among these changes was an at least temporary decline in vaccinations. As a consequence, a decline in adverse events reported to the Vaccine Adverse Event Reporting System (VAERS), a national database that contains reports of adverse events following vaccination, might be expected. The objective of this study was to characterize vaccine adverse events reported to VAERS during the COVID-19 pandemic and compare them to exposures during previous years.
Methods: Cases were adverse events reported to VAERS with a vaccination date of 2018, 2019, or 2020 where the report received date was during that same year or the two months afterward. Reports involving only a COVID-19 vaccine were excluded because preliminary analysis indicated that COVID-19 vaccine only reports accounted for 13,476 (35.9%) of the 37,542 total 2020 reports and the COVID-19 vaccine was not available during 2018 and 2019. The distribution of cases during 2020 was determined for various factors and comparisons made to the previous two years by calculating the percentage difference between 2020 and 2018 and 2019 (percent change between 2018 and 2020, percent change between 2019 and 2020).
Results: A total of 24,066 adverse events were reported during 2020, a 35.6% decrease compared to 2018 (n = 37,344) and 34.8% decrease compared to 2019 (n = 36,935). The distribution by two-month period was January-February - 3,778 during 2018, 4,657 during 2019, 4,176 during 2020 (+10.5%; -10.3%); March-April - 5,262 during 2018, 5,487 during 2019, 2,075 during 2020 (-60.6%; -62.2%); May-June - 6,038 during 2018, 5,564 during 2019, 2,323 during 2020 (-61.5%; -58.2%); July-August – 6,779 during 2018, 6,393 during 2019, 4,719 during 2020 (-30.4%; -26.2%); September-October – 11,183 during 2018, 10,610 during 2019, 9,283 during 2020 (-17.0%; -12.5%); November-December – 4,304 during 2018, 4,224 during 2019, 1,490 during 2020 (-65.4%; -64.7%). The age distribution was 0-5 years – 4,836 during 2018, 4,256 during 2019, 3,163 during 2020 (-34.6%; -25.7%); 6-12 years – 1,695 during 2018, 1,823 during 2019, 1,182 during 2020 (-30.3%, -35.2%); 13-19 years – 2,294 during 2018, 2,070 during 2019, 1,463 during 2020 (-36.2%, -29.3%); 20+ years – 24,933 during 2018, 23,939 during 2019, 15,080 during 2020 (-39.5%, -37.0%). The sex distribution was male – 11,205 during 2018, 10,795 during 2019, 7,113 during 2020 (-36.5%; -34.1%); female – 22,998 during 2018, 22,692 during 2019, 14,307 during 2020 (-37.8%, -37.0%). The distribution by most common vaccines was herpes zoster – 13,615 during 2018, 13,785 during 2019, 7,099 during 2020 (-47.9%, -48.5%); influenza – 9,936 during 2018, 8,397 during 2019, 8,313 during 2020 (-16.3%, -1.0%); pneumococcal – 5,895 during 2018, 4,735 during 2019, 3,257 during 2020 (-44.7%, -31.2%); diphtheria/pertussis/tetanus – 2,638 during 2018, 2,707 during 2019, 1,464 during 2020 (-44.5%, -45.9%).
Conclusions: Adverse events excluding COVID-19 vaccine alone reported to VAERS declined by approximately 35% in 2020 when compared to 2018 and 2019. Declines were observed for all age groups and genders and all of the most common vaccines, although the decline was lower for the influenza vaccine.

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20. Changes in cleaning product-related injuries treated at emergency departments during the COVID-19 pandemic

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Background: Since the start of the COVID-19 pandemic in 2020, to reduce the risk of COVID-19 infection, the Centers for Disease Control and Prevention has recommended that people wash their hands often with soap and water, or hand sanitizer if soap and water are not available, and clean and disinfect frequently touched surfaces daily. However, such recommendations from public health agencies and the media may result in injuries associated with these products. The objective of this study was to identify cleaning product-related injuries treated at United States (US) emergency departments (EDs) in 2020 and compare them to previous years.
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. Cases were injuries reported to the NEISS during 2018-2020 that involved bleach (product code 0956-non-cosmetic bleaches), other cleaners (product codes 0930-household ammonia, 0945-pine oil cleaning and disinfectant preparations, 0951-toilet bowl products, 0953-abrasive cleaners, 0954-general purpose household cleaners), detergents (product codes 0934-dishwasher detergents, 0949-laudry soaps or detergents, 0976-not specified detergents, 0979-dishwashing liquid, 0983-soaps excluding laundry soaps or detergents), or hand sanitizer (hand sanitizer mentioned in the narrative field). The estimated number of injuries reported during 2020 was compared to the estimated numbers reported during 2018 and 2019.
Results: An estimated 19,092 bleach injuries were reported during 2020, a decrease of 7.2% from 2018 (n = 20,571) and 0.6% from 2019 (n = 19,206). An estimated 21,035 injuries to other cleaners were reported during 2020, an increase of 12.9% over 2018 (n = 18,625) and 14.0% over 2019 (n = 18,452). An estimated 41,353 detergent injuries were reported during 2020, a decrease of 32.1% from 2018 (n = 60,939) and 23.8% from 2019 (n = 54,283). An estimated 1,204 hand sanitizer injuries were reported during 2020, an increase of 144.0% over 2018 (n = 493) and 149.9% over 2019 (n = 482). Of the estimated bleach-related injuries, in 2020 14,980 were reported to have occurred at home, a decrease of -1.9% over 2018 (n = 15,271) and an increase of 2.0% over 2019 (n = 14,684); 484 of the estimated bleach-related injuries were reported to have occurred at other locations in 2020, a decrease of 24.9% from 2018 (n = 645) and 48.4% from 2019 (n = 939). Of the estimated injuries to other cleaners, in 2020, 14,523 were reported to have occurred at home, an increase of 11.9% over 2018 (n = 12,980) and 17.8% over 2019 (n = 12,323); 1,874 of the estimated injuries to other cleaners

were reported to have occurred at other locations in 2020, a decrease of 1.0% from 2018 (n = 1,892) and 25.7% from 2019 (n = 2,521).
Conclusion: The estimated number of other cleaner and hand sanitizer injuries treated in EDs increased in 2020 when compared to 2018 and 2019 while the estimated number of detergent injuries decreased and the estimated number of bleach injuries remained relatively constant.

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21. Variations in IV N-acetylcysteine regimens among hospitals consulting the poison center

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Background: Acetaminophen overdose is a frequent call to the nation's poison centers. According to the American Association of Poison Control Centers (AAPCC) 2019 annual report, IV administration of the antidote, N-acetyl cysteine (NAC), is used 10 times more often than oral dosing. The only FDA-approved dosing for IV administration is a 21-hour, three-dose regimen delivered in 3 separate IV bags comprised of a loading dose and two maintenance doses. Each IV bag has a different NAC concentration, with flow rates the same at the bedside to deliver the bag over a predetermined time. Recently, a "single-bag" regimen has been proposed and variously adopted that uses a standardized NAC concentration (usually 3%) for both the loading dose and a single hourly maintenance dose. Dosing is individualized for each patient by using a programmable pump to adjust the infusion rate. The maintenance dose is easily changed with the pump, and many variations are used. Regimens are therefore not standard across hospitals, adding to the complexity for poison centers to manage acetaminophen overdoses at individual institutions.
Methods: To determine institutional variation in IV NAC regimens, a telephone survey was conducted among hospitals that use the state's poison center. Each hospital's in-patient pharmacy was called to communicate with either a staff pharmacist or clinical pharmacist. During each phone call, information was recorded regarding the IV NAC dosing regimen, infusion termination criteria, and IV bag preparation. Responses were recorded on a spreadsheet and then evaluated to identify variations among the regimens.
Results: Of the 127 hospitals approached for the survey, 29 hospital pharmacies could not be reached and three declined to participate. Of the 95 responding hospitals, 90 (94.7%) have a standardized regimen for IV NAC: Nearly half of these (n = 42, 46.6%) follow the FDA approved 3-bag regimen, and half (n = 46, 51.1%) use a variation of the 1-bag, standard 3% concentration regimen. Two hospitals (2.2%) use a 2-bag regimen. Of the 46 hospitals using the 1-bag regimen, 40 recommend a maintenance infusion rate of 12.5 mg/kg/hr over 20 hours, whereas 5 hospitals use 14 mg/kg/hr and one hospital uses 15 mg/kg/hr. All 46 hospitals use the usual loading dose of 150 mg/kg over 1 hour. The vast majority of hospitals allow physician discretion for discontinuing NAC therapy, rather than having specific criteria.
Conclusion: The management of acetaminophen overdoses is in flux, leaving a patchwork of treatments across the hospitals in a single state. It is now not so much the case that the poison center suggests a NAC dosing regimen to a hospital, but that the poison center asks the hospital what regimen they are using. Because acetaminophen overdoses are some of the most common calls to poison centers, it is imperative that the poison center be aware of institutional variations for IV NAC administration so they can adequately perform follow up care and recommendations.

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22. Designer benzodiazepines etizolam and flubromazolam detected in patients with suspected opioid overdose

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Background: A growing number of novel psychoactive substances, including designer benzodiazepines, have become available on the illicit drug market and over the internet. Etizolam, a thienodiazepine, and flubromazolam, a triazalobenzodiazepine, have recently emerged on the illicit drug market in Europe and the United States in recent years. Reports of non-medical use and detection of etizolam and flubromazolam drugs in counterfeit medications appear to be rising, as is their identification in drug-related deaths, often in combination with opioids and other CNS depressants.
Methods: This case series includes adult ED patients who presented to emergency departments within the American College of Medical Toxicology's Toxicology Investigators Consortium (ToxIC) fentalog study group after a suspected opioid overdose. Toxicological comprehensive testing was performed on residual blood samples via liquid chromatography quadrupole time-of-flight mass spectrometry for the presence of over 900 psychoactive substances and their metabolites. Cases with etizolam and flubromazolam identified in biologic samples were reviewed.
Results: Between 10/6/20 and 3/9/21, 141 biological samples of patients suspected of opioid overdose were analyzed from 5 clinical sites encompassing 4 states (Missouri, Oregon, New York, and Pennsylvania). The median age of subjects was 41.9 years (range: 25-69); 80% were male. Etizolam was detected in 10 samples (7%) and flubromazolam in 2 samples (1.4%). Etizolam was confirmed in all states except Missouri and flubromazolam was detected only in Oregon. Oregon had the most exposures overall (N= 5).
In all 10 cases with confirmed presence of etizolam, at least 1 opioid was also identified in biological samples (methadone (n = 6), Fentanyl (n = 3), heroin (n = 2), buprenorphine (n = 1). Flubromazolam, was detected in 2 samples, both from Oregon. Methamphetamine (n = 4) and amphetamine (n = 3) were also commonly detected. The primary reason for the exposure was intentional in all 10 cases, the most common being misuse/abuse (n = 5). No patients received flumazenil. Naloxone was administered in 7 cases. The most common indications for naloxone administration were depressed level of consciousness (n = 5), respiratory depression clinically (n = 3), decreased oxygenation (n = 1), and decreased expired carbon dioxide (n = 1). In 5 cases,

the response to naloxone was known: No response (n = 1), increased respiratory rate (n = 2), improved level of consciousness (n = 4), iatrogenic withdrawal precipitated (n = 1). In 3 cases, 3 or more doses of naloxone was administered. One patient was intubated for acute respiratory failure non-responsive to naloxone. The primary reason for the exposure was intentional in all 10 cases, the most common being misuse/abuse (n = 5). Nine patients were discharged without sequelae and 1 left against medical advice. There were no deaths.
Conclusion: Combined designer benzodiazepine and illicit opioid use can result in synergistic toxicity that may increase the risk of an overdose and/or death. In these preliminary data, etizolam was always identified along with at least 1 opioid, suggesting either addition to the opioid supply or concomitant use.

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23. Cannabis and warfarin interaction on a patient with a left ventricular assist device

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Background: As of April 2021, medical and/or recreational cannabis is legal in all but 6 states. With its availability increasing across the United States, providers must be aware of potential interactions with narrow therapeutic index medications, such as warfarin, due to the metabolism of Δ9-THC by *CYP450*. Patients on warfarin, including those with left ventricular assist devices (LVAD), require strict maintenance of a therapeutic INR and can develop bleeding complications because of this drug-drug interaction.
Case: A 67-year-old woman with an extensive cardiac history requiring placement of a LVAD, rheumatoid arthritis, and chronic pain presented to the ED for evaluation of an INR that was discovered on routine outpatient warfarin monitoring. An INR measured in the ED was 8.3. Her prescribed warfarin dose was 3 mg daily and her INR was subtherapeutic at 1.5 two weeks prior, at which time she received a one-time additional dose of 1 mg of warfarin. She denied changes in diet or recent alterations to her regular medications (lisinopril, metoprolol, spironolactone, paroxetine, aspirin, gabapentin, cyclobenzaprine, pantoprazole, oxycodone, levothyroxine, and metformin). Several months prior, the patient had a similar episode with an INR of 11.1. After further history, the patient disclosed using THC-containing cookies in the last week for her pain. The amount of product consumed varied based on her pain severity. She endorsed similarly using THC edibles in relation to the previous episode of supratherapeutic INR. The patient was counseled to cease the use of THC containing products, and her warfarin was held until her INR was back within therapeutic range at 2.9. She continues to have variation in her INR when using THC containing products and is followed weekly for strict monitoring of her anticoagulation status.
Discussion: Cannabis and warfarin can interact to cause a supratherapeutic INR; however, no such case reports describe this interaction in a patient with an LVAD. Appropriate anticoagulation in patients with an LVAD is critical to preventing device thrombosis while avoiding major bleeding complications. Present guidelines recommend anticoagulation using warfarin with a goal INR of 2-3 and other novel anticoagulation agents are not currently recommended. Unfortunately, this complex patient population may have comorbidities that prompt the use of cannabis to control symptomatology. As availability of cannabis products expands across the United States, patients with LVADs should be counseled on the effects that cannabis may have on the maintenance of anticoagulation with warfarin.
Conclusion: Cannabis use can cause a supratherapeutic INR in LVAD patients on guideline directed anticoagulation therapy with warfarin.

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24. Salicylate toxicity in elderly patient after chronic exposure to a methyl salicylate-containing rubefacient (RUB A535^{TM})

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Background: Rubefacients containing methyl salicylate are commonly used for the treatment of musculoskeletal and pain. While acute salicylate poisoning from oral ingestion accounts for roughly 3-5% of all drug intoxications, chronic salicylate toxicity from overapplication of topical methyl salicylate is relatively rare. Here, we present a case of chronic toxicity in an elderly patient, from percutaneous absorption of topical methyl salicylate.
Case report: A 65-year-old female presented with an exacerbation of shortness of breath not relieved by Ventolin (salbutamol). Her respiration rate was 28, with a blood pressure of 114/76, heart rate of 120 bpm, and 96% O_2 saturation on 2L of O_2. A non-productive cough had worsened over the past 5-7 days. She had a past medical history significant for coronary artery disease with two past STEMIs, COPD with multiple past exacerbations, hypertension, chronic heart failure, and long-standing chronic pain. A 1 to 2 pack per day smoker, her medication list also included alendronate, pantoprazole, Spiriva, Advair, zopiclone, and Tylenol #3 and #4 for her pain. The patient's status continued to worsen despite treatment for an acute COPD exacerbation and CHF, and blood gas revealed a pH of 7.41, a PCO_2 of 15, an HCO_3^- of 10 and an anion gap of 22, with a normal osmolar gap. Acetaminophen and ethanol levels were normal, but salicylate levels were 5.62 mmol/L. The patient mentioned that she sometimes took 81 mg ASA daily but denied overdose. Interestingly, the patient complained of tinnitus for the past several weeks, and nausea, vomiting and diarrhea in the preceding days. As the patient's respiratory distress worsened her mental state deteriorated, she received 3 amps of $NaHCO_3$, was intubated, and referred for urgent hemodialysis. It was later determined that she had been applying large amounts of a methyl salicylate rubefacient (RUB A535^{TM}) over large portions of her body to control her neuropathic pain.
Discussion: Case reports exist that detail concentrated topical salicylic acid preparations. However, there are few case reports that demonstrate chronic salicylate toxicity in an elderly individual from over-use of topical methyl salicylate pain relievers. Salicylate poisoning is often missed in elderly patients, due to clinical overlap with symptoms of concomitant diseases such as COPD and congestive heart failure. As salicylates are primarily excreted by the kidneys, age related decline in renal function may contribute to chronic toxicity. While prescription-grade salicylic acid preparations may contain anywhere between 3-10% salicylic acid, common rubefacients can contain anywhere between 18% to 30% methyl salicylate are available freely over the counter. As many common pain medications (including non-steroidal anti-inflammatories, opioids and muscle relaxants) should be used with caution in elderly patients, they may turn to

available topical over the counter medications as a "safe" alternative.
Conclusions: Methyl Salicylate-containing rubefacients may cause chronic salicylate toxicity that can be overlooked in the elderly patient. Physicians should be aware of the potential risks for salicylate poisoning in such patients.

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25. Thematic assessment of detritus marijuana packaging on the eve of legalization in New York City

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Background: Marijuana is a schedule 1 substance that cannot be possessed within the United States according to federal law. Despite this, several states including Oregon, Colorado, and California have legalized marijuana within their own borders. Since the Obama administration released the *Cole Memorandum* in 2013, federal authorities generally do not prosecute intrastate marijuana commerce. This is similar to the Dutch policy *gedoogbeleid* in which marijuana is explicitly illegal, but tolerated by enforcement policy. States where marijuana is legal prohibit purchase by minors and mandate strict regulation of packaging labels. In states where marijuana is illegal, package labeling is designed at the discretion of marijuana distributors. On March 31 2021, New York State legalized marijuana for sale and consumption. Now that New York has legalized marijuana, the state will likely regulate and standardize packaging requirements. This study assesses various marijuana package labels during the peri-legalization period in New York City.
Methods: From December 2020 until April 2021, sidewalks in the Washington Heights neighborhood of New York City were inspected for discarded packaging materials suspected to be marijuana containers. Packages were collected for study if an olfactory assessment indicated marijuana residue.
Results: A total of 20 packages were included and their labels underwent thematic assessment.
Several packages were labeled as originating from California. Many of these were compliant with California regulations for marijuana labeling. Labels included container contents (cannabis), a triangular warning logo, company name, website, weight, P65 warning, child warning in English and Spanish. Some packages were child resistant. This group of packages appears to have a legitimate Californian origin imported by unknown methods to New York.
Other packages implied Californian origin by including the state designation "CA" adjacent to the state-specific triangular marijuana logo but lacked all or some mandated warning labels. Particularly illustrative are packages labelled "Gorilla Glue" and "Fire OG," which are marketed as California products but are noncompliant with Californian label regulations, suggesting counterfeit merchandise.
Some packages suggest illegality by appropriating nationally recognized non-marijuana related brands. In addition to "Gorilla Glue," a national adhesive brand that is not affiliated with marijuana production, packages in this category include "Joker" and a depiction of "Rick and Morty" from the titular movie and television show, respectively. It is unlikely that legal intrastate marijuana businesses with a tenuous standing under federal drug law enforcement would utilize branding that would attract attention from a national company. Accordingly, it appears this group exploits nationally recognized trademarks to sell an illegal product.
Another subset of packages contained illustrations and written branding (e.g., "Sour Diesel" and "Moneybag Runtz") but no additional text. These imply verbal identification of package contents between distributor and consumer, as well as branding of a particular product. These are distinct from packages with no design or text branding, i.e., clear or monochrome plastic bags and cylinders.
Conclusion: Prior to legalization in New York State, drug suppliers appear to import marijuana from Californian businesses, sell counterfeit Californian marijuana, invoke nationally recognized brands, develop independent brand, and distribute unlabeled packages.

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26. Cobra confusion

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Background: Non-native (exotic) snake envenomations are uncommon in the United States with approximately 30-50 cases/year. These accounted for ~1% of envenomations reported to US poison centers from 2015-2018, with cobra species making up the majority of exotic bites. Monocled cobra envenomation (*Naja kaouthia*) has been described previously in literature and is characterized by rapid local tissue injury and neurotoxic effects.
Case report: A 35-year-old male bitten by his pet monocled cobra (*Naja kaouthia*) on his right forearm presented to an emergency department within 15 minutes complaining of arm pain. Exam: BP 113/54 mmHg, HR 114 bpm, RR 20, temperature 35.4 Celsius, and oxygen saturation 92% on room air. Swelling, and a purpuric area 2cm in diameter was evident at the bite site and the patient started to become diaphoretic and pale. The patient developed tremors and was given lorazepam and morphine. By 3 hours post-envenomation he had difficulty speaking, facial paralysis, increased secretions, and was intubated. Antivenom was located at a local zoo and the patient was transferred. Five vials of neuro polyvalent cobra antivenin were administered ~8 hours post-envenomation with minimal response, prompting another 5 vials given an hour later (which was not relayed to the poison center nor documented on the MAR). Patient's respirations improved overnight and he was extubated the next morning at hour 20 post-envenomation. Extremity weakness was noted on exam and another 5 vials were administered (24 hours post-envenomation) with significant improvement. At 40 hours post-envenomation the poison center was contacted by a different regional poison center and informed they were contacted directly by a provider on the team and had been providing recommendations for the patient's course. Neither poison center was aware the other one was involved. The patient was discharged 72 hours post-envenomation without residual effects. No symptoms of serum sickness were reported during follow-up.
Discussion: This case describes classic toxicity of a *Naja kaouthia* envenomation complicated by management challenges and documentation issues. There was significant confusion over the total number of vials of antivenom administered. The MAR only documented 10 vials of antivenom, however progress notes discussed 15 vials of antivenom administered. The second 5-vial dose was not documented via the MAR. The zoo confirmed that 15 vials were utilized based on what was returned. Additionally, the inadvertent involvement of two poison centers-both completely unaware and believing they were the only ones managing the case-is a unique scenario and highlights an issue of multiple providers receiving different information and providing different management recommendation. This may result in confusion by the treating providers that could impact the

management and outcome of patients. Providers that are contacted about cases outside their poison center jurisdiction should consider contacting the local poison center.
Conclusion: Exotic antivenom administration falls outside the comfort zone of many healthcare professionals and current protocols, resulting in increased risk of errors. In this case, inappropriate documentation and poor communication resulted in confusion over the total vials of antivenom administered and discrepancies in the management recommendations from two different poison centers.

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27. Adverse outcomes associated with promethazine in hospitalized patients

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Objective: The study was aimed to evaluate promethazine use and adverse outcomes in hospitalized patients.
Methods: A single center retrospective chart review of patients hospitalized during 2017-2018 and treated with promethazine was conducted. Medical records were retrived using a computerized query. Exclusion criteria included mechanically ventilated patients and patients who were already treated with promethazine regularly before admission. Primary outcomes included in-hospital post-exposure events: worsening delirium, mechanical ventilation, sudden loss of consciousness, cardiac arrhythmias and mortality. Demographic and clinical data were collected and subjected to comprehensive statistical analysis including uni- and multi-variant regression.
Results: 200 patients were included in the final analysis. Average age of patients was 79 years; 53% were male. Average Charlson comorbidity index was 4.12. Main hospitalization causes were respiratory impairment (20%) and infections (18%). Main indication for promethazine was acute agitation (73.5%). In average promethazine was administered on day 6 of hospitalization (median was day 5). Average duration of stay was 10.5 days (median was 8 days). Mortality rate was 14%. In 18% of patients significant blood pressure changes (>20mmHg) before and after drug administration were recorded. Delirium worsened in 11% and 5.5% experienced fall. 2% of patients developed cardiac arrhythmia and 1.5% were ventilated within 12 hours post administration. Concomitant treatment with benzodiazepines, oxygen saturation in room air below 95% and pulse above 87/min were significantly associated with a higher incidence of adverse outcomes in promethazine treated patients.
Conclusions: Hospitalized patients treated with promethazine have higher in-hospital morbidity and mortality compared to history and literature data. Causality is unclear. It is assumed that as high risk patients with prolonged hospitalizations have higher chance to develop acute agitation secondary to advanced illness and clinical deterioration, promethazine is sometimes used too loosely to suppress the secondary psychoactive state without sufficient prior assessment. This potential unwary medication practice may mask clinical signs and delay diagnosis and treatment of the underline cause of agitation. Appropriate evaluation and exclusion of acute organic impairment is advised before any administration of promethazine. Further research is needed to explore the causal relation of promethazine and the observed adverse events.

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28. Holy COWS: precipitated opioid withdrawal treated with polypharmacy including high dose fentanyl

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Background: Precipitated opioid withdrawal is a complex and dangerous condition. Traditional treatment modalities for withdrawal may be less efficacious when the agents that precipitate withdrawal have long half-lives and high binding affinities. One such agent is buprenorphine, which is increasingly used as part of take home and self-induction protocols, particularly during the COVID-19 pandemic. Clinicians should remain vigilant about the use of these protocols and be aware of the difficulty in treating buprenorphine-precipitated opioid withdrawal.
Case report: A 55 year-old woman presented to the Emergency Department (ED) after ingesting 24/6 mg of a buprenorphine/naloxone co-formulation, which she had been prescribed in the past for opioid use disorder. On the day of presentation, she reported subjective withdrawal symptoms and took 8/2 mg of buprenorphine/naloxone followed by an additional 16/4 mg after she experienced worsening withdrawal symptoms. She felt her withdrawal was worsening and presented to the ED. Initial vital signs were: temperature 36.4 degrees centigrade, heart rate 86 beats per minute, blood pressure 142/111 mmHg, respirations 37 per minute, and oxygen saturation 97% on room air. She was evaluated by a medical toxicologist and noted to have piloerection, agitation, confusion, abdominal pain and cramping, mydriasis, and subjective feelings of severe withdrawal. She was administered 1000 mcg intravenous (IV) fentanyl over the first 1.5 hours, then over the following 18 hours received 12.5 mg IV droperidol, 0.2 mg oral (PO) clonidine, 2 mg intramuscular (IM) lorazepam, 7 mg IV Lorazepam, 60 mg IV ketamine, and a dexmedetomidine IV infusion. By the following morning her symptoms had improved, her vital signs normalized, and she was no longer experiencing subjective withdrawal symptoms. She was discharged on hospital day 3 after declining a buprenorphine induction.
Discussion: This case highlights the difficulty of treating opioid withdrawal precipitated by buprenorphine. Despite large doses of a full opioid agonist (which is often suggested in literature around this topic), our patient's withdrawal symptoms were not controlled. In this case the use of multimodal sedation was effective but did require an ICU admission. This case serves to highlight one of the risks of buprenorphine self-induction. It also demonstrates that consideration of a broader range of treatment modalities for buprenorphine-induced withdrawal may be needed than what has been traditionally considered.
Conclusion: In this case our patient likely began a self-induction before she was clinically in withdrawal which led to precipitated withdrawal. Her symptoms were severe, and while some have suggested that in such cases large doses of buprenorphine may be useful, 24 mg of self administered buprenorphine did not improve her symptoms. Ultimately, large amounts of full opioid agonists were not effective and a combined multi-modal sedation and anxiolytic regimen was needed.

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29. A cross-sectional observational study looking at adverse drug reactions to COVID-19 vaccines reported to a poison center COVID-19 hotline

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Background: Post-marketing passive surveillance of adverse reactions related to the COVID-19 vaccine provides insight into additional side effects and safety issues that may not have been presented or have been identified in clinical trials. A statewide COVID-19 hotline was set up in coordination by the Department of Health. The hotline is a partnership with the poison center and a managed care organization answering general questions from the public, a nurse line answering calls about medical issues, and DOH epidemiologists answering questions from providers. After the FDA Emergency Use Authorized COVID-19 vaccines became available, the poison center was tasked with actively collecting local and timely data of adverse drug reactions, following each patient to outcome, and submitting VAERS reports when indicated. The study aim is to categorize all adverse reactions reported to the state hotline.
Methods: Calls related to adverse reports experienced after administration of the COVID-19 vaccine (either Pfizer-BioNTech, Moderna, or the Johnson & Johnson's Janssen) between January 1, 2021 through May 11, 2021, in individuals 16 years of age and older were recorded and documented on a daily basis. The poison center was notified via secure email of calls received from other partners (nurse line or epidemiology line), and conducted telephone calls to those patients to gather information regarding the reaction and provide advice for therapy if needed. Information recorded for each report included patient demographic information, brand and lot number of the vaccine, reaction onset, type of adverse reaction experienced, treatment issued (if any), and outcome. In this analysis we calculated the incidence rates of each adverse event and evaluated any possible trends. Serious adverse reactions were reported to the Vaccine Adverse Event Report System (VAERS). An attempt was made to follow each case to outcome.
Results: During the study period, 1,638,396 doses of vaccine were administered in the state. There were 370 reported adverse reaction cases (ADRs). The majority of reports were females 270 (72.9%), with a median age of 55. The ADRs with the highest incidence rates were injection-site local reactions (rash, swelling, pain at injection site), non-injection-site local reactions (rash and swelling not at injection-site), and systemic reactions (fatigue, headaches, chills and fever), at 137 (37.0%), 65 (17.5%) and 335 (90.5%), respectively. Unexpected reactions included Guillain Barre Syndrome (1), stroke (3), Bell's palsy (2), shingles (6), tinnitus (10), and vertigo (44). Treatments included analgesics and antihistamines 128 (34.5%) and 83 (22.4%), respectively. Additionally, 32 cases resulted in an emergency room visit,11 in an urgent care visit, and 40 in a provider visit. Onset recorded for 289 cases was: 0-30 min (11.42%), >30 min - 2 hrs (8.30%), >2 - 12 hrs (14.88%), >12 - 24 hrs (14.19%), >1-3 days (21.11%), and >3 days (30.10%).
Conclusions: Poison Centers are uniquely positioned to conduct post-marketing surveillance for new FDA authorized therapies. This study reveals various ADRs reported in one state with one of the highest vaccination rates, and highlights the importance of post-marketing studies to provide an essential safety net for the monitoring of the COVID-19 vaccine.

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30. Bupropion double doses reported to US poison centers from 2006 to 2020

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Background: Bupropion is an antidepressant previously removed from the market due to seizure occurrence in daily doses of 400-600mg. It was reintroduced with a lower dosage of 200-450mg. A previous National Poison Data System (NPDS) study identified high morbidity and mortality with bupropion overdoses. Another study suggested vigilance in bupropion double dose cases. Consensus amongst poison control centers for a referral dose of bupropion (double doses) is lacking albeit common occurrence.
Methods: This was a retrospective chart review of bupropion therapeutic errors reported to the NPDS between 1/2006 to 12/2020. The inclusion criteria for analysis were single substance ingestions coded with the scenario inadvertently took/given medication twice. Based on current data definitions this criteria was chosen to best represent double doses taken in close proximity. Data extracted included patient demographics, management site, clinical effects and medical outcome. The total exposure dose was isolated in milligrams for all evaluable cases using Micromedex product identification codes.
Results: The inadvertently took/ given medication twice scenario was 2.5 times more common than any other therapeutic error, and accounted for a total of 15,590 cases. Case counts remained steady from 2006-2014 then doubled from 2015 to 2020. The majority of cases (93%) were adults 20 years and over. Long acting bupropion accounted for 65.5% of all formulations. The exact dose in milligrams was reported in 14,309 (92%) cases. 4,239 (29.1%) were already en route or referred to a HCF and 10,684 (68.6%) were managed on site. No symptoms were reported in 11,459 (73.5%) of all cases including 6,034 (54.4%) of cases followed to a confirmed medical outcome. Dizziness, agitation, nausea, tremor, and tachycardia were the top 5 reported symptoms. Seizure occurrence in this group was lower than other bupropion therapeutic error scenarios. Seizures were reported in 58 cases (57 single seizure and 1 with multiple seizures). The mean dose ingested across all cases was 498mg and among the single seizure group was 615 mg. The lowest reported total dose with a single seizure was 150mg. There were no cases with a major outcome reported. There were 882 (5.7%) with a moderate outcome, 1,776 (11.4%) with a minor outcome, and 3,114 (20%) had no effect. 7,823 (50.2%) cases were not followed to a known outcome. There were no fatalities reported with the inadvertently took/ given medication twice scenario. Further analysis of select case narratives may provide insight into the impact of prior medical history, timing between doses, verification of dosage amount and confirmation of coded fields.
Conclusion: In the inadvertently took/given medication twice scenario for bupropion ingestions, seizures were reported in a small subset of patients (0.4%) with a total double dose range of 150-1200mg.

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31. Remdesivir associated bradycardia identified through the FDA ACMT COVID-19 ToxIC (FACT) Pharmacovigilance Project

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Background: The American College of Medical Toxicology's (ACMT) Toxicology Investigators Consortium (ToxIC) developed a multi-center active surveillance and reporting system to identify adverse events related to COVID-19 therapies. This project, the FDA ACMT COVID-19 ToxIC (FACT) Pharmacovigilance Project, has identified a signal of remdesivir associated bradycardia. A more detailed investigation into this effect was then undertaken.
Methods: This is an active surveillance project with 15 participating medical centers focusing on identifying possible ADEs, medication errors, toxicity and/or overdose related to any medication or substance administered with intent to treat or prevent COVID-19 infection. Cases are actively identified by direct contact with treating providers, pharmacists, and chart review. Cases were submitted between 11/23/20 and 4/30/21 by site principal investigators and trained research assistants. Utilizing a standardized data collection tool, we gathered specific data including patient demographics, case narrative, exposure details, clinical signs and symptoms, and treatment and outcomes surrounding the ADE. We identified a signal of remdesivir associated bradycardia in FACT's first month. ToxIC alerted the sites and instituted a specific remdesivir bradycardia data collection instrument that includes vital signs, specific signs and symptoms, medication administration records, laboratories before, during and after each remdesivir dose, (potassium, troponin, TSH, creatinine), and relevant cardiac diagnostic studies (e.g. EKG, echocardiogram). Bradycardia was defined as any recorded heart rate <60 beats per minute (bpm) occurring after the start of the remdesivir regimen. Resolution of bradycardia was defined as heart rate >60 bpm sustained for 8 hours or longer. Cases were evaluated for seriousness based on the FDA regulatory definition of serious (21 CFR 314.80). Non-parametric and descriptive statistics were performed in SPSS (v.23, IBM, Armonk, NY).
Results: Between November 2020 and April 2021, 118 cases of remdesivir-related bradycardia were identified. Cases with detailed heart rate information were analyzed (N = 70). Serious effects were identified in 32 cases (45.7%), with 29 being potentially life-threatening. The most common reason for a potentially life-threatening event was a heart rate <45 bpm in 28 cases (87.5%) with 1 case of QRS prolongation (3.1%). There were no deaths in the cases evaluated during the submission period. In most cases (80%, N = 56) 4 or more doses of remdesivir were administered. The median hospital stay was 9 days (IQR 6-14). Lowest heart rate prior to remdesivir was significantly different than lowest heart rate following remdesivir by pairwise chi-square analysis. Bradycardia following remdesivir infusion was more likely to occur after doses 3, 4, and 5 than doses 1 and 2. Eight cases had a total of 10 specific interventions for the bradycardic event.
Conclusions: Bradycardia during remdesivir treatment outside the immediate infusion period has been identified by this study and is a potentially serious unlabeled event. The FACT Project, in collaboration with the FDA, is continuing to collect detailed information on these cases for the evaluation and further characterization of this safety signal.

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32. Management of severe dabigatran overdose: a case report

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Objective: Dabigatran is a direct thrombin inhibitor whose indications are non-valvular atrial fibrillation, deep vein thrombosis (DVT) and pulmonary embolism (PE).
It has a short half-life (12-17 hours), a rapid onset of action (1-2 hours) and it is predominantly eliminated by kidneys and it does not require monitoring, unless in particular clinical situations.
In case of overdose or conditions that lead to toxic concentration of the drug, hemodyalisis, when feasible, and idarucizumab are the main therapeutic options. Idarucizumab is a humanized monoclonal antibody fragment that binds dabigatran with an affinity that is about 350 times higher than that of thrombin.
In this case report prothrombin complex concentrate and idarucizumab were not sufficient to reverse the effect of dabigatran, and only Continous Renal Replacement Therapy (CRRT) allowed to save the patient.
Case report: An 80-year-old woman, who was treated with dabigatran 150 mg twice a day for previous DVT and PE, developed proctorrhagia, diffuse thoracic haematomas, metabolic acidosis and severe alterations of the coagulation tests.
The patient suffered from hypertension, hypercholesterolemia and had been nephrectomised. Despite having a single kidney, the patient had a normal renal function (creatinine 0.9 mg/dl).
At admission there were neither hemodynamic alterations nor pathological neurological or respiratory signs. She developed an acute kidney failure (serum creatinine 2.43 mg/dl, blood urea nitrogen 107 mg/dl) and a severe coagulation alteration. Idarucizumab 5 g was administered without clinical effects. Therefore, she was treated with a second 5 g dose of idarucizumab, prothrombin complex concentrate (50 UI/Kg), and two fresh frozen plasma units. These treatments did not improve the clinical situation, and the proctorrhagia worsened, so she was transferred to the intensive care unit. The dabigatran serum concentration was 6600 ng/ml. After 12 hours without signs of clinical and laboratory improvement continuous veno-venous hemodiafiltration (CVVHDF) was started. Coagulation parameters gradually improved over a period of 72 hours under CVVHDF.
Conclusions: The rapid effect of Idarucizumab is useful in emergency, however, in this case, it did not manage to reverse the intoxication, allegedly as a consequence of the extremely elevated levels of dabigatran and its effects on coagulation.
The acute renal failure and the lack of bleeding till the reach of an extremely elevated serum levels of dabigatran, which prevented the patient from suspending the therapy, might have caused an accumulation of the drug.
Neither a double treatment with idarucizumab, nor a combination of idarucizumab and prothrombin complex concentrate were effective in this case. Only CRRT allowed to interrupt the bleeding restoring effective coagulation, so in presence of extremely elevated serum levels of dabigatran and active bleeding it's seems to be useful CRRT.
Limited information is available about the treatment of severe over-dose. On the basis of this case report, in presence of particular risk factors, a periodical serum level of dabigatran could

be advisable. Moreover, it could be useful to consider CRRT in presence of extremely elevated serum levels of dabigatran and active bleeding.

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33. Intubation thwarted: severe CNS depression after pediatric clonidine overdose reversed with low-dose naloxone

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Background: Clonidine overdoses cause significant morbidity in children and have increased in this population over the past two decades. Intubation for severe CNS depression is not uncommon in these ingestions. We present a case where relatively low-dose naloxone was successful in reversing the CNS depression caused by clonidine toxicity in a six-year-old, preventing the need for intubation.
Case report: A six-year-old girl accidentally ingested 0.6 mg of clonidine in the form of two 0.3 mg tablets which were stuffed into a ball of cheese and intended as an anxiolytic for the family dog. She presented to the emergency department 30 minutes later and was hypotensive, bradycardic, and minimally responsive. She was treated with atropine, IV fluids, and an epinephrine drip with improvement in her heart rate and blood pressure. Her mental status remained severely depressed and, while providers were preparing for intubation, 1 mg of IV naloxone (0.05 mg/kg) was administered. Within a few minutes, the patient became more alert and was soon awake and answering questions. She was started on a naloxone drip titrated between 0.6-1 mg/hr and stayed easily arousable. She was admitted to the pediatric ICU and discharged a day and a half later without sequelae.
Discussion: Administration of naloxone for CNS depression in clonidine overdose has become commonplace, primarily as a means to prevent intubation, which is not without complications. Recent studies have shown that large doses of naloxone are usually necessary, and even then, it may not be an effective antidote. This outcome in this case was surprising because such a low dose of naloxone was successful. It is also worth noting that clonidine used for anxiolysis in animals can be particularly dangerous in pediatric ingestions because the doses are often higher than those used in humans.
Conclusion: Low-dose naloxone has the potential to be effective in reversing the CNS depression caused by clonidine overdose in the pediatric population. Starting doses of 0.05-0.1 mg/kg are reasonable.

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34. Increased pediatric edible cannabis exposures in Illinois after legalization and during the COVID-19 pandemic

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Background: Illinois recently became the 11th state to legalize cannabis in the U.S. and consumers have been able to buy cannabis for recreational use in the state since Jan 1, 2020. In Illinois, the availability of legal marijuana products coincided with the COVID-19 pandemic. Although COVID-19 led to a state-wide stay at home order in March of 2020, cannabis dispensaries remained open as they were considered essential businesses. Edible marijuana products are by far the most likely to lead to pediatric exposures, since they closely resemble regular candy, brownies, and other sweets appealing to children. In other states that have legalized marijuana, the increase in availability of edibles after legalization resulted in an increase in pediatric ingestions between 2-3 times that seen in states where it is illegal, according to a recent national study.
Methods: Data from our regional poison center (RPC) was retrospectively queried for all ingestions of edible cannabis products in children less than six years of age for the three-year period 2018-2020. Data extracted included type of edible product ingested, patient age and gender, disposition, and severity of clinical effects.
Results: There was a 13.6-fold increase in pediatric edible exposures from 2018 to 2020 (1263.6% increase). There were 150 exposures to edible marijuana products in children younger than 6 years reported to our RPC in 2020. This is up from 11 edible exposures in 2018 and 35 in 2019.
Minor effects were the most common medical outcome in this age group throughout the study period. Severe clinical effects such as seizures and the need for intubation were not seen in 2018. However, 5 patients (3.3%) had severe effects in 2020. The percentage of patients requiring admission decreased slightly, with 5 patients (45%) requiring admission in 2018, and 58 (38.6%) in 2020.
Conclusions: Pediatric edible cannabis exposures in Illinois increased significantly in 2020, far more than expected compared to the increase reported in other states after legalization of recreational cannabis. This is likely multifactorial and may be related not only to the new legal status of the products, but also to COVID-19 pandemic-related quarantines. It may be that due to the pandemic, pediatric patients spent more time in their homes, with more opportunities to ingest a family member's edibles. To reduce unintentional exposures in this age group, increased poison prevention awareness and education should be delivered to parents and caregivers who use cannabis products.

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35. Adverse drug events associated with monoclonal antibodies used in the treatment of COVID-19

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Background: The American College of Medical Toxicology's Toxicology Investigators Consortium (ToxIC), in collaboration with the Food and Drug Administration (FDA), developed the FDA ACMT CoVid-19 ToxIC (FACT) Pharmacovigilance Project, a multicenter active surveillance and reporting system to identify previously unrecognized adverse drug events (ADEs) related to COVID-19 therapies. Among the emerging COVID-19 treatments, neutralizing monoclonal antibodies (mAbs) are being used as therapy for adult and pediatric patients with diagnosed COVID-19 infections. The mAbs with neutralizing activity against COVID-

19 include bamlanivimab (alone or in combination with etesevimab) and casirivimab in combination with imdevimab. More information, particularly real-world data, is needed to understand the optimal use and the possible ADEs associated with these therapeutics beyond clinical trial data.
Methods: This is an active pharmacosurveillance project with 15 participating medical centers across the United States. The project focuses on identifying possible ADEs, medication errors, toxicity, and/or overdose related to any medication or substance administered by a healthcare provider in an inpatient or ambulatory setting, or by patient self-administration with intent to treat or prevent COVID-19 infection. Cases are actively identified via site specific mechanisms including direct contact with treating providers, pharmacists, and chart review. ADEs associated with neutralizing mAbs were captured between 11/23/20 and 4/30/21 by site principal investigators, and trained and monitored dedicated research assistants. Utilizing a standardized mAb data collection tool developed by ToxIC in conjunction with the FDA, data was collected on vital signs, signs and symptoms, outcome, and laboratory before, during, and after administration.
Results: A total of 62 cases of potential mAb-associated ADEs were reported during this time period. As shown in Table 1, the majority of ADEs (N = 54, 87%) occurred within 12 hours of the medication administration. As detailed in Table 2, 50 (81%) cases reported more than one ADE. The majority of the ADEs were pulmonary (N = 18, 29%), immunologic (N = 16, 26%), and cardiovascular (N = 12, 19%).
Conclusions: The FACT Pharmacovigilance Project was created as a novel multi-site pharmacosurveillance program to monitor real-world adverse events related to therapies being used for the treatment and prophylaxis of COVID-19, including mAbs. Most reported mAb ADEs were pulmonary, immunologic, or cardiovascular and the majority occurred within 12 hours of administration. Although these ADEs were reported to be associated with mAb therapy, causality assessments are ongoing. This project is continuing to identify ADEs associated with mABs and other COVID-related therapeutics.

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36. Rapid development of the FDA ACMT COVID-19 ToxIC (FACT) pharmacovigilance pilot project to monitor adverse events reported in association with COVID-19 therapeutics

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Background: When the COVID-19 pandemic emerged, many treatments were administered either off-label, under U.S. Food and Drug Administration (FDA) Emergency Use Authorizations, or through compassionate use programs. The rapid spread and high mortality of COVID-19 emphasized a need to develop a surveillance system to identify adverse drug events (ADEs) specifically related to emerging COVID-19 therapeutics. In addition to conducting routine surveillance, FDA contracted with the American College of Medical Toxicology's (ACMT) Toxicology Investigators Consortium (ToxIC) to establish a novel multi-center active surveillance network to capture ADEs associated with COVID-19 therapeutics.
Methods: In October 2020, ToxIC recruited medical toxicology site investigators from 15 medical centers across the United States to establish a pilot toxicosurveillance program to proactively identify and report ADEs associated with COVID-19 therapeutics to a new ToxIC Sub-registry. This FDA ACMT COVID-19 ToxIC (FACT) Pharmacovigilance Project focused on providing timely data about adverse drug events associated with exposures to medications or substances used for the treatment or prevention of COVID-19 in inpatient and outpatient settings. Site-based research assistants worked with the principal investigators at all 15 sites to proactively identify cases of interest via site-specific mechanisms. These included reports from medical toxicology consultations, the patient's treatment team, the pharmacy, and by chart review. A HIPAA-compliant web-accessible REDCap data collection instrument was developed in collaboration with the FDA to facilitate case submission and provide for real time reporting. Over the initial 6 months of data collection, case identification criteria evolved to specifically target serious (e.g., death or hospitalization) and unlabeled adverse drug events. FDA Disclaimer: This abstract reflects the views of the author and should not be construed to represent FDA's views or policies.
Results: Between 11/23/20 and 4/30/21, 513 cases were submitted across all 15 sites. Through close collaboration with the FDA and continued assessment of emerging literature, investigators were guided to identify important ADE signals. For example, we developed a data collection form specific for remdesivir-associated bradycardia (heart rate below 60 after therapy initiation), which ToxIC shared with the sites, leading to the identification of 118 cases.
Conclusion: In partnership with the FDA, ToxIC rapidly developed a multi-center pharmacovigilance pilot project to help identify and analyze ADEs associated with COVID-19 therapeutics. Early identification of potential safety signals and creation of enhanced data collection instruments allowed timely investigation of the potential causality and clinical significance of adverse drug events reported with COVID-19 therapeutics. This project demonstrates that in the face of a national public health emergency, ToxIC can adapt to collect real-time data for public health analysis.

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37. A new application of an old drug: antimuscarinic toxicity secondary to moist towelettes containing glycopyrronium tosylate

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Background: Glycopyrrolate is an antimuscarinic drug that is commonly used for management of secretions in the operative setting and in palliative care. However, newer formulations of

glycopyrrolate are now being used in the outpatient setting for management of hyperhidrosis. Glycopyrrolate acts primarily via antagonism at M1 receptors with some antagonism at M3 receptors as well. Excretion from sweat glands is primarily mediated through M3 receptors. Qbrexzaâ is a topical formulation of glycopyrrolate marketed for primary axillary hyperhidrosis. The package insert lists urinary retention as a warning, however, an open label study evaluating adverse effects with use of topical glycopyrronium found antimuscarinic effects in less than 5% of patients. We report a case of severe antimuscarinic toxicity from topical glycopyrronium tosylate treated with physostigmine.

Case report: A 25-year-old female with a past medical history of primary axillary hyperhidrosis presented to the emergency department with difficulty urinating, anxiety, and changes to her vision of three days duration. She had recently been prescribed Qbrexzaâ (2.4% glycopyrronium tosylate) moist towelettes for hyperhidrosis and reported using 1 sheet daily. Vital signs were as follows: heart rate 115 beats/min, temperature 37.2 C, respiratory rate 18 breaths/min, blood pressure 118/80 mm Hg, and oxygen saturation of 97% on room air. Physical examination revealed 6 mm sluggishly reactive pupils, dry skin, dry mucus membranes, tachycardia, absent bowel sounds, and a distended, palpable bladder. She was alert and oriented yet appeared very anxious. Urinary catheterization revealed 1,200 mL of urine. Her work up included an EKG with sinus tachycardia, QRS 80 msec, QTc 464 msec. Blood work including CBC, CMP, acetaminophen, and salicylate concentrations were unremarkable. She was given 1.5 mg of physostigmine with improvement in her heart rate and anxiety but required a foley catheter at discharge for persistent inability to void. At follow up, she had a complete recovery and glycopyrronium tosylate was discontinued.

Discussion: Severe antimuscarinic toxicity is uncommon with use of topical glycopyrronium tosylate. Glycopyrronium is a quaternary ammonium compound therefore not expected to cross the blood brain barrier nor cause central symptoms. While physostigmine is typically reserved for antimuscarinic delirium, given the severity of her symptoms requiring catheterization, physostigmine was administered with hopes of eliminating need for catheter at discharge. Unfortunately, even after resolution of her tachycardia and other antimuscarinic effects, her urinary retention persisted requiring catheter at discharge. Neostigmine is a quaternary ammonium compound of equal potency to physostigmine and would have been an acceptable alternative in this patient. Perhaps higher doses of physostigmine or neostigmine may have been able to ameliorate her urinary retention, but it is unclear whether she would have experienced bradycardia given normalization of her heart rate with 1.5 mg physostigmine. When taking a medication history, patients often fail to disclose non-traditional medications such as over the counter medications and topical agents; it is important to ask about topical preparations, both prescribed and over the counter, in patients with antimuscarinic symptoms.

Conclusions: Topical glycopyrronium tosylate, although uncommonly reported, can cause significant antimuscarinic toxicity.

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38. Milk-alkali case series: atypical presentations with hypocalcemia and hypermagnesemia

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Background: Milk-alkali syndrome is a well-described syndrome characterized by hypercalcemia, metabolic alkalosis and acute kidney injury (AKI) with nausea, vomiting, weakness and altered mentation. Acute and chronic forms exist; both result from the ingestion of large amounts of calcium and an absorbable alkali, typically in patients using milk or antacids to treat peptic ulcer disease. We present three cases of milk-alkali syndrome, including two variant presentations of note.

Case series: Case 1: A previously healthy 28-year-old male was found down with four bottles of vodka. On presentation, he appeared intoxicated despite an undetectable blood alcohol level. His vitals were unremarkable save mild tachycardia. A cranial hematoma prompted a CT, a subsequent seizure begot intubation. Laboratory studies were significant for metabolic alkalosis, AKI and hyponatremia. The patient responded to fluid resuscitation and electrolytes abnormalities resolved without dialysis. He was extubated on hospital day 3, without recollection of his ingestion.

Case 2: A 57-year-old female with anorexia nervosa reported ingesting 12 bottles of milk of magnesia and 60 bisacodyl tablets 16 hours earlier. On arrival she was lethargic and cachectic-appearing, with ongoing vomiting and diarrhea. Reflexes were normal. Vital signs were unremarkable with exception of mild hypotension (95/64) . QTc was 597msec. Laboratory studies were concerning for hypermagnesemia. Electrolyte derangements responded to supportive care without hemodialysis. Serum calcium levels were unavailable.

Case 3: A 50-year-old male with chronic ethanol and polysubstance use presented agitated to the ED. Vital signs were notable for pulse 110, breathing 22 respirations/minute. Ongoing agitation led to sedation and intubation. Laboratory studies revealed mixed metabolic alkalosis, respiratory acidosis and hypercalcemia. Total calcium improved to 8.3mg/dL, and he was extubated on hospital day 7. Family reported ingestion of "a bottle of Tums® every 2 days."

Discussion: We present three cases of suspected milk-alkali syndrome. The first two cases present variations on the typically reported syndrome with acute renal failure, alkalosis and hypermagnesemia without hypercalcemia following suspected alkali magnesium salt exposure. These are strikingly similar to the third case, a classic presentation, only they are without hypercalcemia due to differences in ingestion types. The first case cannot be explained by other causes of metabolic alkalosis such as GI losses, diuretics, excessive licorice intake, or mineralocorticoid excess. Milk-alkali syndrome from magnesium based antacids is therefore the most likely diagnosis. The second case had a reported ingestion of milk of magnesia further complicated by a known eating disorder leading to hypermagnesemia, renal failure and alkalosis. We postulate that, like the classic presentation in case three, use of non-calcium based alkaloids can present with similar metabolic derangements and renal failure.

Conclusion: Milk alkali syndrome presents with a largely diagnostic constellation of laboratory abnormalities suggestive of the diagnosis. These cases highlight the possibility of alkali magnesium-based antacids and digestive aids (such as Mylanta®) as alternative drivers of the syndrome. Although none required hemodialysis, all patients required close monitoring or active airway management, a point of particular note when caring for milk-alkali syndrome, including those resulting from magnesium-based antacids.

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39. Phentermine as a cause of peri-coital cardiac arrest

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Background: The obesity epidemic has popularized the use of various diet pills and supplements. Infamous among these is fenfluramine/phentermine (fen-phen), which was removed from the market by the FDA in 1997 after it was linked to cases of valvular heart disease and pulmonary hypertension. Phentermine remains available as monotherapy for obesity. We present a case of ventricular fibrillation (VF) cardiac arrest where after extensive workup, the only possible causal finding was use of diet pills containing phentermine.
Case report: A previously healthy 40-year-old woman (BMI 24.5 kg/m2) became unresponsive during intercourse with her husband, who began CPR and contacted EMS. She was in VF when EMS arrived. She was defibrillated twice and regained spontaneous circulation.
On emergency department arrival she was tachycardic (130 beats/minute) and tachypneic (29 breaths/minute) without hypotension. Initial ECG showed sinus tachycardia, short PR interval (118ms), non-specific intraventricular conduction delay (QRS 120ms), QTc of 440ms, and inferior ST depressions. She was intubated for persistent coma and was cooled to 33 °C. Chest CT showed consolidation bilaterally with no evidence of pulmonary embolus. Thyroid studies were normal, and there were no serious electrolyte abnormalities (initial potassium 3.2 mEq/L).
Following admission, an echocardiogram obtained on hospital day (HD) 2 showed normal ejection fraction and no wall motion abnormality. Cardiac MRI on HD 4 showed an ejection fraction of 30%, but otherwise no evidence of scar, valvular abnormality, or other significant pathologic findings. On repeat imaging 2 days later, EF had increased to 45%. Coronary angiography performed on HD 6 showed no evidence of significant atherosclerotic disease. She did have intermittent Premature Ventricular Contractions (predominantly of right bundle branch origin), but had no evidence of monomorphic ventricular tachycardia degenerating into fibrillation.
She self-extubated on HD 3, and was discharged home on HD 10. Urine chromatography/mass spectrometry revealed only phentermine and trazodone. The patient reported taking "diet pills" prescribed by a "diet doctor." Moreover, she had clinical evidence of phentermine withdrawal during her intensive care stay. Given her extensive cardiac workup was non-diagnostic, phentermine is the most likely culprit inducing myocardial sensitization which led to cardiac arrest. She underwent ICD placement prior to discharge.
Discussion: Phentermine is a weight loss drug that is structurally related to amphetamine. It facilitates weight loss likely via a combination of decreasing hunger perception and increasing basal metabolism. Prior case reports have associated phentermine with cardiac arrest and ventricular arrhythmias. As an amphetamine derivative, it increases release of norepinephrine and dopamine. The exact cause of cardiac toxicity is unknown, but may be related to excessive norepinephrine release that acts on the cardiac conduction system while also increasing myocardial contractility. Phentermine may have caused myocardial sensitization or vasospasm of the coronary arteries which could have been further stressed during the act of coitus.
Conclusion: Phentermine should be considered in patients with sudden cardiac arrest, particularly when no signs of underlying cardiac abnormalities are evident. While phentermine remains available, the risk of life-threatening dysrhythmias should be considered before it is prescribed.

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40. Zinc exposures reported to poison control centers 2018-2020: another COVID effect?

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Background: Zinc supplementation is advertised for a variety of health benefits, from boosting immune response to treatment of cold viruses, diarrhea, and macular degeneration. While a well-balanced diet generally contains adequate amounts of zinc, many internet sources recommended zinc supplementation as a potential preventive measure against SARS-CoV-2, the virus that causes COVID-19. Unfortunately, zinc excess can cause toxicity including GI upset, headache, and impairment of copper, iron, and cholesterol balance in the body.
Objective: We sought to determine whether zinc exposures reported to poison control centers increased after the onset of the COVID-19 pandemic, and features of these cases which might inform prevention.
Methods: NPDS was queried for human exposures from January 1, 2018 through February, 2021 with a substance of Zinc (using the generic substance code 0169000). Data were additionally analyzed for two periods from 1/1/18 to 2/29/2020 and 3/1/2020 to 2/28/21, using March 2020 as the beginning of the pandemic. Statistical significance was established at $\alpha = 0.05$. Descriptive statistics, correlation coefficients and ANOVA were used to evaluate temporal trends. This study was exempt by the Institutional Review Board of the authors' institution.
Results: There were 7476 exposures during the study period, with an increase in monthly case rates of 118% ($p < 0.05$) from mean of 143 cases per month with little increase (r^2 of 0.05) to mean of 312 cases per month with ongoing rise (r^2 of 0.45). While the increase is largely driven by "no effect" and "minor effect" cases, there is a rise in moderate cases as well. Seasonal increases were observed each year during influenza season (January). The majority of exposures were due to therapeutic error, unintentional-general and adverse drug reactions. Cases were more common in the age groups of 40-60 years, with a smaller peak between 19-20 years.
Discussion: Several supplements and antiviral measures have gained popularity in the COVID-19 pandemic with resultant increases in poisoning exposures. Examples include hand sanitizers, cleaners and disinfectants, hydroxychloroquine, and cold remedies such as colloidal silver. Zinc exposures appear to follow a similar pattern and while the majority of cases have mild effects, some sustained preventable injury as a result of this unproven therapy against COVID-19.
Conclusion: Cases of zinc exposure with toxicity called to poison control centers have more than doubled since the COVID-19 pandemic began. Education about the proper usage and storage of supplements may help mitigate this trend. Also, emphasis on proven therapies to prevent and treat COVID-19 may realign behaviors in those seeking alternative therapies.

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41. An atypical use of MDAC: enhanced elimination of quetiapine in a massive overdose

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Background: Quetiapine is a commonly prescribed atypical antipsychotic xenobiotic. Overdose has been well described in the literature leading to hypotension, profound sedation, and an antimuscarinic toxidrome. There are case reports of massive overdose requiring prolonged intubation. Due to its high volume of distribution (Vd) and protein binding, quetiapine cannot be adequately cleared through extracorporeal elimination. Single-dose activated charcoal (SDAC) has previously been shown to decrease the relative fraction of quetiapine absorbed. Current overdose kinetic data are limited, but suggest multi-dose activated charcoal (MDAC) may enhance the elimination of quetiapine and prevent a prolonged hospitalization. We report a case of a massive quetiapine overdose treated with MDAC which successfully decreased the apparent half-life.
Case report: A 34-year-old male with an unknown past medical history presented to the emergency department with tachycardia, hypoxia, and somnolence. The patient was found with an empty bottle of quetiapine 100 mg with a prescribed quantity of 180 tablets. Initial vitals were HR 118, BP 126/76, RR 18, SPO_2 92% on room air, and GCS 9. Oxygen saturation improved with nasal cannula and tachycardia improved with IV fluids (IVF). Five hours after arrival, the patient declined to a GCS 4 with an SPO_2 80% on 2L nasal cannula with significant inspiratory stridor. The patient was intubated for airway protection and placed on sedation with fentanyl 50 mcg/hour. The maximum QTc interval was 566 ms. Based on the history of ingestion, pharmacokinetic properties of quetiapine, and the presence of a secured airway with a nasogastric (NG) tube, toxicology recommended to administer MDAC at 50 grams every 6 hours via NG tube for 24 hours. Serial quetiapine levels were obtained on presentation and before each MDAC dose. After three doses of charcoal, the patient improved to GCS 15 and required multiple fentanyl boluses to remain sedated. The patient passed a spontaneous breathing trial and was extubated to room air 24 hours after initiation of MDAC. The QTc improved to 452 ms. The initial serum quetiapine level was 3300 ng/mL drawn 22 minutes after arrival with an unknown time of ingestion and decreased to 260 ng/mL by 30 hours post presentation. The initial apparent half-life of quetiapine in this patient was 17.35 hours. After initiation of MDAC, the apparent calculated half-lives on subsequent draws decreased to 5.34 and 5.56 hours respectively.
Discussion: MDAC administration appeared to decrease the half-life of quetiapine in a patient with a confirmed massive overdose requiring endotracheal intubation. Potential mechanisms for this finding include prevention of prolonged absorption from decreased GI motility secondary to anticholinergic effects of quetiapine, bezoar formation, or enterohepatic recirculation of the parent drug or metabolites, a finding seen in animal studies.
Conclusion: Use of MDAC in intubated patients after massive quetiapine overdose may help to enhance the elimination of the drug, facilitate earlier extubation, and decrease ICU and hospital length of stay. Further investigation is warranted to confirm these findings and assess the effect of MDAC on active metabolites.

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42. What's the buzz about "wasping"?

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Background: Pyrethroids are effective wasp paralytics that bind and keep the voltage gated sodium channel in its open state, functioning as an axonic excitotoxin. When sprayed, heated and dryed its crystalline nature bears a likeness to methamphetamine. This physical semblance and some cross over with the methamphetamine high has led to its abuse as a cheap, accessible and dangerous trend. We describe a case of "wasping" in a chronic methamphetamine user.
Case report: A 39-year-old hepatitis C patient who by admission was both a heroin and methamphetamine user, presented to an emergency department (ED) with new onset choreoathetoid movements. She relayed a recent history of using "wasp dope." She was subsequently admitted and her clinical course was significant for agitation, rhabdomyolysis (CPK 8,188), tachycardia 100 BPM, QTc of 487, and elevation of liver enzymes (AST 257, ALT 147). Her symptoms and labs improved over a course of 3 days with the institution of symptomatic and supportive care, which included midazolam and haloperidol for her agitation, and intravenous fluids.
Discussion: The practice of "wasping" involves spraying the wasp spray onto a metal screen connected to a battery. The heat melts the product and upon cooling the crystallized pyrethroid is injected alone or in conjunction with methamphetamine. Alternatively, it may be inhaled. Wasp spray typically includes the type II pyrethroid group which provide a better kill. These contain an α-cyano group which imparts more neuronal hyperexcitation than the cyano devoid type I pyrethroids. Blockage of voltage-sensitive chloride channels produce enhanced central nervous system (CNS) toxicity. Choreoathetosis, as experienced by this patient, has been described in the literature. Other reported type II pyrethroid effects in users include paresthesias, salivation, tachycardia, dyspnea, ataxia, tremor, hallucinations, erratic behavior, and seizures. Metabolism occurs in the blood and liver and a case report of fulminant liver failure has previously been reported. Little can be elucidated of the patient's baseline drug use and hepatitis C history's impact on her clinical course. It is important to note that there are no readily available labs or tests for pyrethroids.
Conclusion: Awareness of "wasping" and the effects of intravenous pyrethroids continues to evolve. Pyrethroid misuse should be considered in the differential for methamphetamine users who present with new onset neurologic symptoms.

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43. Emergency department buprenorphine initiation: a qualitative study of attending physician attitudes, beliefs and practices

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Background: Opioid use disorder (OUD) remains a major source of morbidity and mortality within the United States (US). Emergency Department (ED) ED-initiated buprenorphine (BUP) has been shown to increase engagement in treatment and reduced opioid misuse. However, rates of ED BUP initiation are low. This study aims to understand ED attending physician attitudes, beliefs and practices toward BUP initiation.
Methods: We interviewed a purposive sampling of ED attending providers at two urban, tertiary-care academic EDs within a New York City healthcare system from July 2019 to April 2021. We conducted focused, semi-structured qualitative interviews examining provider background/knowledge, beliefs and attitudes as well as practical and logistical concerns. Our interview guide was created utilizing a grounded theory framework. Three researchers independently coded transcripts using an iterative, open-coding approach.
Results: We conducted 14 interviews with physicians who had varying levels of prior experience administering and prescribing BUP. Analytic domains included barriers, facilitators, patient characteristics, provider needs, attitudes/beliefs on addiction and public health implications. Commonly identified barriers to Buprenorphine initiation included training/waiver concerns, perceived lack of institutional support, concerns regarding patient follow-up and logistical barriers. Commonly identified facilitators included prior experience/comfort, sense of duty as a physician and patient motivation. Several interviewees perceived BUP to be superior to methadone and felt this perception increased likelihood of initiating BUP. Several interviewees also identified the role of the ED in treating OUD as a factor in BUP initiation with some viewing this as a facilitator and others as a barrier. Increased ancillary support and institutional protocols for BUP initiation and improved follow-up infrastructure were identified as key provider needs.
Conclusion: In this qualitative study of ED attending physicians, we identified facilitators and barriers to initiating BUP in the ED. Interviewees also noted various provider needs for more widespread adoption. Interventions focused on addressing identified barriers and provider needs should be designed and implemented to increase rates of ED buprenorphine administration and initiation.

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44. Outcomes of law enforcement officer administered naloxone

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Objective: Law enforcement officer (LEO) administered of naloxone is an effective intervention for treating prehospital opioid overdoses. Our objective is to determine the rate and factors associated with adverse behavioral effects and efficacy following LEO naloxone administration.
Methods: This is a retrospective cohort study of patients treated with naloxone law enforcement agencies in a single urban county between January 2016 and December 2020. Law enforcement agencies affiliated with this county typically utilize 4mg/0.1mL intranasal naloxone kits to be administered to persons who are thought to be possible victims of a drug overdose. Data were acquired from forms completed by LEO following administration of naloxone. Variables included gender, suspected agent(s) implicated, number of doses given, apparent response to naloxone, transport refusal, and death. We performed descriptive statistics. Univariate regression analysis with a primary outcome of improved neurological status and a secondary outcome of patient irritability/combativeness post-naloxone was performed for all variables with an n of 10 or greater.
Results: A total of 511 cases of LEO administered naloxone were reported, with 370 (72%) receiving one dose and 136 (28%) receiving 2 or more doses. Naloxone was felt to be effective by the LEO in 322 (63%) of these cases with 6 (1%) exhibiting combativeness and 52 (10%) having the composite outcome of irritability or combativeness. Transport was refused by 72 (14%) patients and 26 (5%) patients died. Per the univariate analysis, there was no statistically significant relationship between successful response to naloxone and the variables of gender, number of doses given, presence of any non-opioid, or suspected exposure to oxycodone. The perceived rate of efficacy was higher when an opioid, rather than a non-opioid agent was suspected (239/346 [67%] vs. 83/165 [50%], OR 2.21, 95% CI 1.51-3.23), and for heroin and fentanyl specifically. Patients were more likely to refuse transport after successful response to naloxone (52/322 [16%] vs. 18/189 [10%], OR 1.91, 95% CI 1.09-3.37). For the secondary outcome of irritability or combativeness following naloxone administration, suspected exposure to fentanyl was the only variable associated with this outcome (7/22 [32%] vs. 45/489 [9%], OR 4.60, 95% CI 1.78-11.8).
Conclusions: LEO administered naloxone remains an effective intervention for overdose victims, with higher perceived efficacy when opioids are specifically implicated. Combativeness is rare following LEO naloxone administration. Further research is needed to understand a relationship between suspected fentanyl intoxication and post-naloxone behavioral disturbances, which could be causal in nature.

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45. Drip it and forget it? adverse effects of sodium bicarbonate infusions for poisoned patients

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Background: Sodium bicarbonate ($NaHCO_3$) is a potential treatment for several poisonings and can be given as a bolus therapy or via infusion. Use of $NaHCO_3$ can cause several adverse effects including significant hypernatremia ($\geq$ 150 mEq/L), hypokalemia ($<$ 3.5 mmol/L) and alkalosis (pH $\geq$7.5). The rates of these adverse effects when $NaHCO_3$ is used as an infusion for the treatment of poisoned patients is not well described. We sought to evaluate the characteristics and adverse effects associated with $NaHCO_3$ infusions when used to treat poisoned patients.
Methods: This was an IRB approved study. The medical record of an academic medical center was queried for all orders for $NaHCO_3$ infusions from 1/1/2014 to 12/31/2019. Cases were then screened to select only those involving poisonings. The following date was collected: age, sex, substance involved, reason for poisoning, beginning, end and rate of $NaHCO_3$ infusion, initial sodium, potasssium, and pH along with peak sodium, lowest potassium, and peak pH during admission. Times for all lab data was recorded.
Results: A total of 71 cases were identified. Average age was 38.3 years (range 15 -73; SD 15.5). Forty cases (56%) were female. Forty-seven cases (66%) involved a single substance. There were 47 different known substances involved. Four case involved unknown substances. The most common substances were

acetaminophen (n = 17), aspirin (n = 16) and amitriptyline (n = 6). Average duration of admission was 7.8 days (SD 10.7). Sixty cases (84%) were admitted to the ICU and 7 deaths occurred. The average duration of the $NaHCO_3$ infusion was 24.83 hours (SD 43.18). The average infusion rate was 98.7 ml/hr (SD 82). In 39 cases $NaHCO_3$ boluses were also given. Sixty-eight cases had serum sodium measured prior to infusion initiation with average initial sodium of 138.5 mEq/L (SD 4.5). In 28 cases the patient's highest serum sodium occurred during the infusion with average result of 144.5 mEq/L (SD 4.4). These high sodium levels occurred 9.45 hours (SD 19.33) into the infusion. In 3 cases the peak sodium level was ≥150 mEq/L with single case reaching 157 mEq/L. In 68 cases serum potassium was measured prior to infusion initiation and averaged 4.1 mmol/L (SD 0.9). In 28 cases the patient's lowest serum potassium occurred during the infusion with an average of 3.0 mmol/L (SD 0.4). In 24 cases the serum potassium was ≤3.5 mmol/L and in 12 cases it was <3.0 mmol/L including a low of 2.1 mmol/L recorded in 2 cases. The lowest potassium levels occurred 11.22 hours (SD 16.23) into the infusion. The serum pH was measured prior to the infusion in 52 cases and averaged 7.26 (SD 0.21). In 25 cases the patient's highest pH occurred during the infusion with an average result of 7.46 (SD 0.1). In eight cases the pH rose to 7.5 or greater with a single case high of 7.62. The peak pH occurred on average 13.57 hours (SD 19.6) into the infusion.
Conclusions: Treatment of poisoned patients with $NaHCO_3$ infusions appears to rarely result in significant hypernatremia or alkalosis. However, hypokalemia was relatively common and occasionally severe.

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46. Anti-histamine misuse and abuse: trends and characteristics reported to NPDS

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Background: Anti-histamines, particularly first-generation anti-histamines, have the potential to be misused or abused for their psychoactive effects. The characteristics and trends of intentional misuse and abuse of these antihistamines is not well described in the medical literature. We sought to characterize the intentional misuse and abuse of diphenhydramine, doxylamine and hydroxyzine reported to the National Poison Data System (NPDS).
Methods: This was a cross sectional study consisting of NPDS data collection utilizing quantitative data for the period of 1/1/2007 to 12/31/2020. The NPDS was queried to identify all single agent human exposures coded as intentional – misuse or intentional - abuse for diphenhydramine, doxylamine and hydroxyzine followed to a known outcome. All data entered into NPDS was collected and analyzed using Microsoft Excel (*Microsoft Corp., Redmond, Washington*, 2010).
Results: There were 20596 cases identified. 58% (n = 11979) involved adults. The average age was 32 years (SD 14) for adult cases and 15 years (SD 5) for pediatric cases. The year with the highest number of reported cases was in 2020 for both pediatric (n = 797) and adult (n = 1029) cases. Graph 1 shows the cases per year and demonstrates the 71% increase for pediatric cases and 76% increase for adult cases over the study period. As Graph 1 shows, the increase in both groups was driven almost solely by increasing diphenhydramine misuse and abuse. In all, diphenhydramine accounted for 86% (n = 7415) of pediatric cases and 85% (n = 10234) of adult cases. There were 11 deaths reported and all involved diphenhydramine.
Conclusions: Misuse and abuse of antihistamines reported to the NPDS has demonstrated significant increased over the last 14 years in both pediatrics and adults. Diphenhydramine misuse is most common and results in significant morbidity and rare mortality.

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47. Tales of tequila tails: chronically elevated methanol levels in a chronic user of tequila

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Background: Agave-based spirits have previously been identified as containing variable quantities of non-ethanol alcohols and other volatiles (Lachenmeier et al, 2006), and methanol is known to be present at low levels in multiple consumer-marketed alcoholic beverages. We report a patient with recurrent emergency department presentations for acute ethanol toxicity from the consumption of commercial tequila, with incidental, chronically elevated methanol levels.
Case report: a 48-year-old male with at least 35 emergency visits over a 3-year period for ethanol intoxication and related maladies presented with chest pain, nausea, and shortness of breath after 3 days of heavy ethanol consumption and immediately after ingesting 2 gallons of milk to prevent a hangover. He endorses vomiting with possible aspiration; otherwise review of systems was unrevealing. He explicitly denied ingestions other than tequila, his drink of choice.
On arrival, the patient was markedly tremulous with significant vital sign derangements: presenting pulse was 135 beats/minute, blood pressure 160/87mmHg, temperature 38.1 °C, 38 respirations/minute, and a saturation of 94% on room air. He had a pronounced anion gap acidosis (bicarbonate 9mEq/L, anion gap 35, venous pH 7.25) and acute kidney injury (creatinine 1.76mg/dL). Ionized calcium was mildly decreased (4.13mg/dL, range 4.4 - 5.2), and blood ethanol concentration was 0.109g/dL. White blood cell count was 33k/mm3. Diagnoses of aspiration pneumonia and ethanol withdrawal were made, and the patient was treated accordingly. Methanol concentration, ordered to fully evaluate anion gap acidosis, returned positive at 6mg/dL.
Over the following three years, the patient presented frequently with related complaints. Blood methanol concentrations were evaluated on 12 episodes, and were detectable on 11 of these. On only one occasion was methanol detectable without concurrently detectable ethanol. The inpatient toxicology service formally evaluated at the bedside, and he was seen in the emergency department by toxicologists on multiple occasions. Documented histories were consistent, in that the patient reported drinking only tequila and occasional beer; he thoroughly denied intentionally or accidentally ingesting other substances. He endorses working as a painter, raising the possibility of occupational exposure to methanol, but denied excessive exposure to methanol-based thinners. Neither the regional Poison Control System nor the inpatient toxicology service ever recommended alcohol dehydrogenase inhibition due to low methanol concentrations and the co-presence of ethanol.
The persistent presence of both ethanol and low-level methanol was consistent with both the patient's history and with the known presence of methanol in distilled spirits, particularly tequila. While concern was raised for the possibility of adulterated or poorly manufactured spirits causing resulting methanol

concentrations, the patient's history, contextualized in the known low concentrations of methanol in tequila, seems a more plausible explanation for the persistently detectable methanol levels over several years' time.
Conclusion: Chronic, low-level methanol may be identified with chronic, excessive tequila ingestions. Whether due to adulteration or to low concentrations of methanol in these spirits remains unclear, representing an avenue for further investigation to minimize this uncommonly identified manner of methanol exposure.

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48. Clinical effects and treatment of patients following overdoses of brorphine and butyrylfentanyl

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Background: Brorphine is a novel piperidine-based opioid of similar potency to fentanyl associated with opioid-related fatalities, first appearing in the United States in June 2020. Butyrylfentanyl is a short-acting fentanyl analog associated with morbidity following an overdose. This case series from the ToxIC Fentalog database reviews the clinical course of emergency department (ED) patients presenting following either a brorphine or butyrylfentanyl overdose.
Methods: The ToxIC Fentalog database is an ongoing cohort study within the ToxIC network at nine sites located across the United States. Consecutive ED patients with an acute opioid overdose and available waste blood samples drawn as part of clinical care were screened, and we excluded pediatrics, prisoners, and those with non-toxicological diagnoses. Information including but not limited to demographics, substance use history, psychiatric history, clinical course including if the patient received naloxone, vital signs and laboratory information, and disposition were collected following a chart review. Left over blood samples were obtained from all included patients and sent to the Center for Forensic Science Research and Education (CFSRE) for analysis. Discarded blood samples were collected and toxicological confirmation was performed via liquid chromatography quadrupole time-of-flight mass spectrometry for the presence of over 900 novel psychoactive substances and their metabolites.
Results: Between 9/21/20-3/9/21, 481 patients were screened and 173 met inclusion criteria. Of these, 5 patients tested positive for either brorphine (N = 2) or butyrylfentanyl (N = 3). All 5 patients were evaluated at Barnes Jewish Hospital in St. Louis, MO, which enrolled 34 patients into the database during the time period. No patient was positive for both substances. Ages ranged from 36-75 years and 3 were male. Three patients had a history of non-substance related psychiatric illness. All 5 patients received naloxone, with 2 receiving it in the hospital and 3 by EMS. One patient that used butyrylfentanyl received 3 doses of naloxone and was intubated in the ED and admitted to the intensive care unit. He had infiltrates on his CXR and remained intubated for 40 hours and required vasopressors. His initial lactate was 10.7 mmol/L with a pH of 6.95 and CO_2 of 101. All the other patients were discharged from the ED with a length of stay ranging from 8-13 hours. One patient who was positive for brorphine had suicidal intent and was admitted to psychiatry. Another patient following an accidental overdose tested positive for butyrylfentanyl and was admitted to psychiatry and started on naltrexone for an alcohol use disorder. Clonazolam, cocaine, levamisole, lidocaine, quinine, methamphetamine, heroin, and acetylfentanyl were confirmed in the 2 patients that tested positive for brorphine. Xylazine, lidocaine, quinine, cocaine, methadone, tramadol, and levamisole were confirmed in the 3 patients that tested positive for butyrylfentanyl.
Conclusions: Brorphine and butyrylfentanyl were detected in 5 patients presenting to a single hospital in St. Louis following an acute opioid overdose. Interestingly, no patients tested from the other project sites during the time period had the presence of either substance. All 5 recovered uneventfully, although one patient with butyrylfentanyl had a prolonged ICU course with multisystem organ failure.

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49. How much baclofen is enough? A case report of a phenibut withdrawal seizure occurring on 10 mg three times daily of baclofen for symptom management

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Background: Phenibut is a widely available GABA-B receptor agonist that, when taken chronically, causes dependance and subsequent withdrawal from stopping use. One tool employed in phenibut withdrawal is baclofen, a GABA-B receptor agonist structurally related to phenibut. Baclofen doses reported for phenibut withdrawal are often much higher than FDA approved dosing (60-120 mg daily). We present a patient being treated for phenibut withdrawal who experienced a seizure on baclofen 10 mg TID. This case highlights a potential risk of underdosing baclofen in the management of phenibut withdrawal, despite being near maximal FDA approved doses.
Case: Day 1: A 31-year-old male with anxiety, depression and substance use disorder was brought to the emergency department (ED) by family for lethargy and confusion starting earlier that day. On arrival he was hypertensive, tachycardic, tachypnic, and lethargic. His home medications included naltrexone, trazodone, gabapentin, clonidine, citalopram, and buspirone. The patient could not provide a history but the family found a 500 g bottle of phenibut half full at home and reported a history of phenibut withdrawal 8 months prior to this episode. Per family, during the prior withdrawal episode the patient experienced delayed psychosis 5 days after stopping phenibut. The patient received 1 mg of IV lorazepam and was admitted to the hospital for presumed baclofen withdrawal.
Day 2: The patient's mentation improved to baseline and vital signs were normal. Due to his history of delayed symptoms withdrawal symptoms, he was started on baclofen to prevent decompensation. He received two doses of baclofen 10 mg over 8 hours and was discharged home on baclofen 10 mg TID.
Day 3: The patient returned to the ED (28 h from discharge) after having a seizure at home. Baclofen was increased to 20 mg TID and he was admitted for observation. At this visit he was able to report using 25-30 grams of phenibut daily for the past six

months.
Day 4: The patient began experiencing nausea, tremors, and hallucinations. He received 70 mg of baclofen PO and 5mg of lorazepam IV over 6 hours but symptoms persisted. He then received phenobarbital 390 mg IV over 4 hours (260 mg x 1, 130 mg x 1). His tremors and agitations resolved. The next morning he was awake, alert, oriented, and cooperative. His home medications were restarted except for trazadone and he was started on 40 mg TID of baclofen.
Day 5: He continued to improve and was discharged on his home medications and baclofen 40 mg TID with a plan to taper 5 mg daily each week.
Discussion: The role of baclofen in phenibut withdrawal requires more study. This case highlights a potential risk with under dosing baclofen especially when used as monotherapy. Additionally, as this patient's condition worsened 24h after presentation, clinicians should be aware of the potential for delayed decompensation in phenibut withdrawal.
Conclusion: When treating phenibut withdrawal, clinicians should be cognizant of the potential for delayed decompensation and be comfortable exceeding FDA approved dosing of baclofen.

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50. Can metronidazole cause a disulfiram-like reaction? A propensity matched comparison of disulfiram-like effects in patients with analytically confirmed ethanol concentrations who did or did not receive metronidazole

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Background: There is controversy over the existence of a metronidazole induced disulfiram-like reaction. Uncontrolled case reports suggest metronidazole can cause a severe disulfiram-like reaction in combination with ethanol. Criticism of these cases suggest the observed effects appear to be as likely caused by ethanol than by a drug interaction. Further, controlled human and animal studies fail to demonstrate any increase in systemic acetaldehyde concentrations or objective symptoms of disulfiram-like reactions. Yet, metronidazole carries a warning to avoid co-administration within 72 hours of ethanol. The purpose of this study is to retrospectively assess the incidence of clinical effects consistent with a disulfiram-like reaction in a population of patients with analytically confirmed ethanol concentrations who received metronidazole. As alcohol may also be responsible for the effects seen, the incidence of effects will be assessed against a control group propensity matched for age, sex, and ethanol concentration.
Methods: A retrospective chart review was performed from 12/01/2010 to 12/31/2020 on emergency department patients with analytically confirmed ethanol concentrations who received metronidazole. The incidence of disulfiram-like effects occurring at any point after metronidazole administration were recorded. Disulfiram-like like effects were defined as nausea, vomiting, flushing, tachycardia, hypertension, hypotension and use of an anti-emetic. Medical records were also searched for the term "disulfiram". The incidence of these effects were compared to a propensity matched group with the same ethanol level, age, and sex. Ordinal variables were compared using Fisher's Exact Test, and continuous variables via a student t-test.
Results: A total of 48 patients were included in the study, 24 in the metronidazole group and 24 in the propensity matched control. The groups were equally matched in ethanol concentration, sex, and age. More patients in the metronidazole group were admitted to the hospital and receiving antibiotics compared to the propensity matched group (admission: metronidazole $n = 19$, propensity match $n = 2$, $p < 0.00001$, antibiotics: metronidazole $n = 24$, propensity match $n = 1$, $p < 0.0001$). No patients who received metronidazole with ethanol had a suspected disulfiram reaction documented in the medical record. There was no significant difference in incidence of tachycardia, nausea, vomiting, flushing, hypotension, or anti-emetic use between groups. There was significantly more hypertension in the propensity matched group compared to the metronidazole group (metronidazole $n = 3$, propensity match $n = 15$, $p < 0.0001$).
Discussion: This small data set supports that disulfiram-like effects are similar in ethanol intoxicated patients regardless of metronidazole exposure. Despite propensity matching, more patients who received metronidazole were admitted to the hospital and received antibiotics. This would bias results toward observing more effects in the metronidazole group and may signal toward a sicker population. However, no disulfiram-like reactions were identified and clinical effects were similar. The study is limited by its small sample size. Further studies with larger sample sizes may consider additional propensity matching by admission status and receipt of antibiotics to better control for severity of illness.
Conclusion: This data further supports the lack of a disulfiram-like reaction when metronidazole is used in patients with recent ethanol use.

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51. Clonazolam and fentanyl: what's in your local drug supply?

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Background: The fourth wave of the opioid epidemic is described as fentanyl PLUS many other substances, including designer benzodiazepines such as clonazolam, which is an analogue of clonazepam and a potent $GABA_A$ agonist. Co-exposure of designer benzodiazepines with illicit opioids may confound antidotal treatment, delay therapeutic response, and in the long term, lead to addiction and withdrawal. We report a regional clonazolam outbreak in ED patients with illicit opioid overdose.

Methods: This is a case series from the Toxicology Investigators Consortium (ToxIC) Fentalog study group, an ongoing cohort study at nine sites located across the United States. Consecutive adult ED patients from 5 participating facilities who presented following a suspected acute opioid overdose were screened for enrollment, which included comprehensive toxicological testing. Waste clinical specimens were analyzed via liquid chromatography quadrupole time-of-flight mass spectrometry for the presence of over 900 psychoactive substances and their metabolites. Cases with clonazolam identified in biologic samples were included in this series, and medical records review was performed.
Results: In patients evaluated between 10/6/20–3/9/21, out of 141 samples taken from presumed opioid overdoses from 5 clinical sites encompassing 4 states (Missouri, Oregon, New York, and Pennsylvania), 11 blood samples detected the presence of clonazolam. Of these 11 patients, 8 (72.7%) were positive in Pennsylvania, 2 (18.2%) in Missouri, and 1 (9.1%) in Oregon. All ranged between ages 18-65 (mean age =37) and the majority occurred in men (N = 8, 72.7%). Current sedative/hypnotic use (use <30 days prior) was reported in 1 (9.1%) and unknown use history in the other 10 (90.9%). Naloxone was given in 9 (81.8%) and the response after treatment with the first dose was known in 7 of these cases. Out of these 7 patients, no response with first dose was noted in 4 (57.1%), and improved level of consciousness was noted in 2 (28.6%). There were no deaths.
Conclusion: This case series confirms an ongoing clonazolam outbreak. Clinicians should recognize that illicit opioid overdoses may not fully respond to naloxone due to the presence of designer benzodiazepines.

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52. Subacute, reversible neurotoxicity and ataxia due to excessive huffing of ethyl chloride

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Background: Ethyl Chloride is a colorless, volatile liquid that was previously used as a general anesthetic and is currently used as a topical anesthetic. Ethyl chloride is also commercially available as a DVD/VCR cleaner. There is an emerging trend of recreational huffing to enhance sexual relations, similar to the abuse of alkylated nitrites ("poppers"). We describe a case of neurotoxicity due to repeated abuse of ethyl chloride, which is scantly reported in the literature.
Case report: This is a single case report of an adult patient. A 36-year-old HIV-negative man with a history of intermittent ethyl chloride huffing for 15 years presented to the emergency department with an inability to walk for four days. The patient reported a rapid titration of huffing from zero to eight cans of 4.6 oz ethyl chloride aerosol per day over a one-week period. The patient recreationally used marijuana but denied other inhalants or drug use. He had stopped using ethyl chloride three days prior to presentation. A similar episode of ataxia occurred one month prior after heavy use of ethyl chloride, which resolved over two weeks. He reported a negative MRI brain during that evaluation. The patient was abstinent from ethyl chloride abuse during the period of prior symptom resolution until this recent binge. Initial vital signs were heart rate 88 bpm, blood pressure 147/60 mmHg, temperature 99 °F, and respiratory rate 16. Physical exam was notable for slurred speech, ptosis, a wide-based and ataxic gait with short strides, inability to stand without support, loss of toe/finger proprioception, horizontal and vertical nystagmus, bilateral finger-to-nose dysmetria, bilateral mild heel-to-shin dysmetria, and normal strength and sensation. Laboratory data was notable for bicarbonate of 20 mmol/L, creatinine 1.21 mg/dL, and alkaline phosphatase 35 U/L. Otherwise, laboratory data were normal. CT brain and MRI of the brain, cervical, thoracic, and lumbar spine demonstrated no acute abnormalities. During his initial hospitalization, the patient had minimal improvement in his symptoms. However, on symptom day 9, he started to improve and was able to ambulate with mild difficulty when using a cane. The remainder of his neurologic exam had normalized by day 10 of symptoms and he was discharged. On two-week follow up, the patient reported minimal difficulty ambulating with a cane. He had no other neurologic symptoms or complaints.
Discussion: Toxicity from excessive ethyl chloride huffing is scantly reported in the literature. Toxicity in this case was characterized by cerebellar findings, no attributable laboratory abnormalities, and no radiographic abnormalities on CT/MR. The neurotoxicity was subacute and spontaneously resolved with supportive care. Neurologic symptoms after ethyl chloride abuse have been reported although the pathophysiology is poorly understood.
Conclusion: Ethyl chloride is widely available and easily obtained. It is gaining popularity as a potential inhalant/drug of abuse. This case of excessive huffing of ethyl chloride resulting in neurotoxicity with normal imaging characterizes a rare complication of ethyl chloride abuse.

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53. A case of bromism without hyperchloremia

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Background: Bromism, or chronic bromide poisoning, is rarely seen today. It can result from misuse of dextromethorphan hydrobromide/chlorpheniramine maleate 30 mg/4 mg (Coricidin HBP Cough & Cold). Symptoms include hypertension, hallucinations, tremors, and hyperreflexia. In many cases, chloride levels are falsely elevated due to bromide interference, and this is often key in diagnosis. This case describes a patient with bromism but with a normal chloride level and profound liver dysfunction that improved with N-acetylcysteine (NAC) administration.
Case report: A 31-year-old male with history of polysubstance use and cardiomyopathy with a left ventricular ejection fraction (EF) of 43% presented with confusion, abdominal pain, vomiting, and fever. Four days prior to admission, he took 32 pills of dextromethorphan/chlorpheniramine (960 mg of dextromethorphan and 128 mg of chlorpheniramine). He reported using this medication daily for 10 years for its hallucinogenic effects. His blood pressure on arrival was 153/102. Labs and mental status were consistent with hepatic failure with AST >7000 and ALT 4239 although the ammonia level was normal. He was transferred to a hospital with liver transplant capabilities and NAC was started empirically. An echocardiogram showed worsening EF of 20-25%. Physical examination showed tremulousness, mild ocular clonus, tachycardia, and bilateral lower extremity hyperreflexia. Viral serologies as cause for liver failure were negative. Ceruloplasmin was normal and imaging ruled out Budd-Chiari. He denied use of hepatotoxic medications including acetaminophen (level <0.1). Toxicology was consulted and recommended checking a

bromide level. His hepatic dysfunction was not clearly attributed to chlorpheniramine or another medical cause. Features of his presentation were consistent with bromism from daily use of dextromethorphan hydrobromide. His bromide level was found to be 110 mg/L (reference level 0.9 - 7.3 mg/L). Despite this elevated bromide level, the patient's chloride on presentation was 103 mmol/L. His liver enzymes improved with NAC, diuresis, and afterload reduction. Ultimately, the patient was discharged with behavioral health follow-up for substance use disorder.

Discussion: This case describes a 31-year-old male with dextromethorphan use disorder who presented with symptoms of bromism. Although the bromide level was elevated, his chloride was normal. Bromism has occasionally been described with a normal chloride. This patient's normal chloride level may be secondary to worsening heart failure or recent diarrhea. The chloride laboratory assay in this case did not exhibit significant bromide interference, and the degree of interference varies by technique. The bromide level in this case is lower than some previous cases. This may be because the level was checked approximately five days after his last use of dextromethorphan hydrobromide, and he had received intravenous fluids. Another notable point is the patent's severe liver injury that improved with NAC. Bromism-induced hypertension likely reduced his cardiac output and contributed to hepatic ischemia.

Conclusions: Bromism should be considered in patients with chronic use of dextromethorphan hydrobromide. This case illustrates that a patient may have an elevated bromide level without false hyperchloremia. A diagnosis of bromism should be considered with a normal chloride level in the appropriate clinical setting.

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54. Repeat positive urine drug screens in a patient after stopping long-term fentanyl use

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Background: While many illicit drug users inadvertently use fentanyl when it is substituted for their intended substance, some users deliberately seek out and use fentanyl. There is limited information regarding the elimination kinetics of fentanyl in chronic heavy users. Because of its distinct chemical structure, fentanyl is not detected by traditional urine drug screens (UDS) that detect opiates unless a fentanyl-specific test is performed.

Case report: A 40-year-old female with a history of polysubstance use presented to the methadone clinic for help with opioid use disorder (OUD) and housing instability. The patient reported injecting cocaine and 2-3 grams of "fentanyl" per day. She was started on methadone 20 mg/day which was increased over four weeks to 45 mg/day. Her UDS was positive for fentanyls on her day of presentation (day 0) and confirmed by liquid chromatography-mass spectrometry (LC-MS), with serum fentanyl and norfentanyl concentrations of 20.0 and 337.0 ng/mL, respectively. On day 23, her random UDS was positive for fentanyls, and a confirmatory test was also positive for fentanyls with serum fentanyl and norfentanyl concentrations of <0.5 and 0.7 ng/mL, respectively. The patient was suspected of relapse based on the positive confirmatory test and discharged from clinic-associated housing despite her denial. A repeat UDS on day 30 was negative for fentanyls. The patient struggled to maintain sobriety due to her housing instability and relapsed on day 45, testing positive by UDS for fentanyls on day 51.

Discussion: The lipophilic drug tetrahydrocannabinol is known to be detectable by UDS for several weeks after a heavy chronic user stops using marijuana. However, recognition of this phenomenon for other highly lipophilic drugs like fentanyl is much more limited. Medical use of fentanyl is usually short-term, but heavy chronic use of illicit fentanyl may occur multiple times per day over many weeks. This patient's UDS was still positive for fentanyls >3 weeks after her last use. While it is possible that she was not truthful about relapsing, a comparison of the confirmatory testing results from days 0 and 23 is more consistent with her self-report of not relapsing. The repeat LC-MS was negative for the parent drug fentanyl, and at 0.7 ng/mL was barely above the detection limit of 0.5 ng/mL for the norfentanyl metabolite. Both values are significantly decreased from her presenting fentanyl and norfentanyl concentrations. Consistent with these findings, a study of 12 OUD patients found that the mean(-max) UDS clearance times were 7.3(19) and 13.3(26) days for fentanyl and norfentanyl, respectively. Thus, the more likely explanation for the patient's positive repeat test results is that small amounts of fentanyl continued to redistribute from her body fat over time, with detection of norfentanyl by the highly sensitive urine testing.

Conclusions: Similar to what is observed in marijuana users, heavy chronic use of fentanyl can lead to lingering positive UDS results for several weeks after the patient ceases use. Toxicology and addiction providers should consider the highly lipophilic properties of fentanyl in order to correctly interpret UDS results in these patients.

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55. Opioid overdose REACT (resuscitation education for addiction counselors and trainees) knowledge translation project preliminary results

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Background: Addiction counselors provide opioid overdose education to clients and may have an increased likelihood of encountering an overdose emergency due to working with a high-risk client population. Few data exist regarding the ability of addiction counselors to describe opioid pharmacology fundamentals, to recognize opioid overdose signs and naloxone resuscitation indications, or to have confidence to intervene in an opioid overdose with nasal naloxone.

Methods: This longitudinal pilot study evaluated the effectiveness of an educational program on the knowledge base and confidence of addiction counselors and counseling trainees to intervene in an opioid overdose. Inclusion criteria included employment as an addiction counselor in the institutional addiction counseling department or enrollment as a trainee in the addiction counseling Masters program. Eligible participants received a REDCap link via email to provide consent and demographic information. Refusal to provide consent was the only exclusion criterion. Consented participants received an initial survey two weeks before the training and a follow-up survey the week afterward.

The course content included four hours of didactics about opioid agonists and antagonists, the opioid toxidrome and indications for resuscitation, legal issues, and hands-on nasal naloxone trainer experience. The survey included ten pharmacology and

naloxone resuscitation knowledge questions and five confidence questions. Preliminary analysis was performed after the first two survey administrations, using paired t-tests.
Results: Ten addiction counselors and 15 trainees were eligible to participate in this ongoing study. Of these, 9/10 counselors (90% response rate) and 15/15 trainees (100% response rate) agreed to participate. 22/24 consented participants (92%) completed the pre-course survey and 21/24 (88%) completed the post-course survey.
There was a significant increase in participant knowledge scores (mean increase 1.8/10 correct answers; $p = 0.001$) and confidence scores (mean increase 6.25/20 points; $p < 0.001$). Both knowledge and confidence scores increased among participants with high school or college education levels (knowledge scores 1.9/10 correct answers; confidence scores 7.4/20 points; $p = 0.019$ and $p < 0.001$, respectively). Among participants with a Masters degree, only the confidence scores increased significantly (mean increase 4.9/20; $p = 0.014$). Among participants with <1 year or >5 years of work experience, the increase in knowledge scores was not significant, but their confidence scores increased significantly (mean increase 8.5/20; $p = 0.001$ and 4.5/20; $p = 0.040$, respectively). Among participants with 1-5 years of work experience, both their knowledge and confidence scores increased significantly (mean increase 2.3/10; $p = 0.028$ and 5.0/20; $p = 0.001$, respectively).
Conclusions: Opioid and naloxone pharmacology training is critical in addiction counseling education to maximize counselor effectiveness in working with substance use disorder clients and to prepare them to respond to overdose emergencies. This curriculum improved short-term addiction counselor and trainee opioid pharmacology knowledge, recognition of opioid overdose signs, and confidence in using naloxone and counseling clients about opioid pharmacology.
Further data collection to measure participants' knowledge retention and sustained confidence to intervene in an opioid overdose will occur at six- and 12-months post-course.

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56. Medical outcomes of combined methamphetamine and opioid exposures compared to single substance methamphetamine or opioid exposures reported to a single poison center

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Background: In the past decade, there has been an increasing incidence of reported co-exposure of methamphetamine with opioid substances. While the increase in combined methamphetamine and opioid use has been widely reported, there have been few studies reviewing the medical outcomes of these types of ingestions and even fewer studies reviewing the medical outcomes of combined methamphetamine and opioid use compared to opioid use alone or methamphetamine use alone. This study aims to evaluate whether combined methamphetamine and opioid use leads to worse medical outcomes than methamphetamine use alone or opioid use alone.
Methods: This was a retrospective chart review of methamphetamine exposures, opioid exposures, and combined methamphetamine-opioid exposures reported to a single poison center between January 1, 2016 to December 31, 2020. All opioids were included. Exclusion criteria included cases that were unable to be followed until closure of the case, cases that were coded as confirmed non-exposures, as well as those coded as indirect deaths. Medical outcomes were defined according to the American Association of Poison Control Centers NPDS coding manual. After filtering the data to the three categories above, the data was filtered to only include one line per exposure. Descriptive statistics were used to compare medical outcomes in methamphetamine only exposures and opioid only exposures to combined methamphetamine and opioid exposures.
Results: A total of 2,106 exposures were included in this study, 488 methamphetamine only exposures, 1,534 opioid only exposures, and 84 combined methamphetamine-opioid exposures reported over the 5 year period. Approximately, 58.33% of the combined methamphetamine-opioid exposures resulted in moderate effect, major effect, or death (MMD) compared to 64.75% of the methamphetamine only exposures (OR 0.76, 95% CI 0.48-1.23) and compared to 43.94% of the opioid only exposures (OR 1.78, 95% CI 1.14-2.81). Similarly, 39.29% of the combined methamphetamine-opioid exposures required admission to a critical care unit compared to 44.88% of the methamphetamine only exposures (OR 0.80, 95% CI 0.49-1.27) and 27.64% of the opioid only exposures (OR 1.70, 95% CI 1.07-2.66).
Conclusions: Compared to opioid only exposures, combined methamphetamine-opioid exposures had a significantly worse medical outcomes and more critical care unit admissions. However, there was a non-significant trend towards worse medical outcomes and more critical care unit admissions in methamphetamine only exposures compared to combined methamphetamine-opioid exposures. The power of this study is limited by the low number of combined methamphetamine-opioid exposures compared to the methamphetamine only and opioid only exposures. Further study is needed to better understand why combined methamphetamine-opioid exposures lead to worse medical outcomes than opioid only exposures.

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57. Methanol madness: abuse of hand sanitizers resulting in serious toxicity and death

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Background: Methanol is a colorless, volatile, flammable, and highly polar liquid. Due to its toxic metabolites, methanol is a well known to cause an anion gap (AG) acidosis with retinal blindness, other end organ injury and death. The Food and Drug Administration (FDA) issued the first of several advisories on June 19, 2020, regarding hand sanitizer products found to contain up to 81% methanol, despite not being listed as an ingredient. We report two cases resulting in serious toxicity and death after suspected ingestion of hand sanitizer as an alternative ethanol source.
Case report: Case 1: A 36-year-old female with previous history of overdose, hand sanitizer ingestion, and recreational cold medication use called EMS due to shortness of breath and dizziness while reportedly detoxing from alcohol. While initially anxious with normal oxygenation for EMS, upon arrival to the emergency department (ED) she became altered and minimally responsive. She was intubated and sedated and an orogastric tube suctioned dark secretions from her stomach. Labs showed pH <7.0, HCO3 2.1mEq/L, AG 24, Lactic Acid 3.1mmol/L and non-detectable ethanol. A sodium bicarbonate (NaHCO3) infusion was started at

300ml/h and she was admitted to the ICU. An initial methanol level was 200mg/dL. Fomepizole was given and emergent hemodialysis performed for 4 hours. Methanol level after dialysis was 12mg/dL. She did not improve and was determined to be brain dead on day 4.
Case 2: A 30-year-old female presented to the ED for alcohol detoxification reporting her last drink was several hours earlier. On arrival she was verbally responsive, blood pressure 126/93 mmHg, pulse 100 bpm, respirations 18/min, oxygen saturation 96% on room air, AG 31 and CO_2 5mmol/L. She received IV fluids, lorazepam for agitation, and an IV bolus of 150mEq of NaHCO3. Her condition rapidly declined, and she was intubated and admitted to the ICU. The acidosis worsened (pH 6.75, HCO3 3.9mEq/L) and a NaHCO3 infusion was initiated at 200ml/h. The family found 4 empty bottles of hand-sanitizer, however her ethanol level was non-detectable. A toxic alcohol ingestion was suspected and fomepizole and continuous renal replacement therapy initiated. Initial methanol level was 260mg/dL. Ten hours after arrival it was 76mg/dL, 21 mg/dL 22 hours post-arrival, and <10 mg/dL on day 3. She was discharged on day 21 with no complications.
Discussion: Hand sanitizers are known to be abused due to their high concentrations of ethanol or isopropanol coupled with low cost and availability. Tainted hand sanitizers are now a novel source of methanol exposures. While neither patient admitted to ingestion of hand sanitizer, both had histories or evidence of hand sanitizer abuse. Each presented with methanol levels >200mg/dL, non-detectable ethanol levels and demonstrated significant AG acidosis resulting in a severe outcome and death.
Conclusion: Despite FDA warnings, methanol-containing hand sanitizers are available and ingestions can result in extremely high methanol levels with significant morbidity and mortality. A high index of suspicion is warranted and treatment with fomepizole and hemodialysis should be considered early.

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58. Effects of Senate Bill, S .3187, amendment .2151, on decreasing hydrocodone related deaths

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Objective: The National Center for Health Statistics (NCHC) at the Center for Disease Control and Prevention (CDC) has documented a steady rise in drug related deaths over the last 2 decades. Hydrocodone played a key role in those trends as one of the most prescribed medications in the United States prior to its reclassification. There are five different schedules of controlled substances, as described by the United States Controlled Substances Act. The 5 schedules are based on; potential for abuse, accepted medical use, and potential for addiction. Schedule 3 drugs are categorized as having a moderate to low potential for abuse, and schedule 2 have high potential for abuse and dependence. On October 2014, Senate Bill, S .3187, amendment .2151, was enacted to change medications containing hydrocodone from a schedule III to a schedule II. Under this reclassification, traffickers are subject to increased fines and penalties, patients need an original prescription for refills, and the products would be stored and transported more securely. The intent of this Bill was to reduce abuse and deaths associated with hydrocodone overdose in the United States (U.S.). The purpose of this research is to determine if Senate Bill .3187, amendment .2151 decreased hydrocodone related deaths in the 11% of the U.S. Poison Centers (PC) reviewed from 2014 to 2020.
Methods: A retrospective data review was conducted from 11% of the PC's in U.S. from 2014 to 2020 to determine if after the passing of Senate Bill .3187, amendment .2151 there was a decrease in hydrocodone overdose fatalities.
Results: The PCs under review documented 660 toxic deaths from 2014 to 2020. The percentage of deaths from a toxic exposure where hydrocodone was documented as one of the medications involved in relation to overall reported deaths are as follows: 2014: 4.7% of 64, in 2015: 3.8% of 78, 2016: 1.23% of 81, 2017: 1.88% of 106, 2018: 3.5% of 84, 2019: 1.16% of 86, and in 2020: 2.1% of 94. Prior to the reclassification the percentage of deaths documented involving hydrocodone in relation to overall deaths were as follows, 2013: 2.9% of 67, 2012: 5.4% of 73, 2011: 5.3% of 75.
Conclusions: The data showed a 46.88 % rise in overall drug related deaths between 2014 and 2020. The review of data did not show a significant decrease in deaths associated with the reclassification of hydrocodone form schedule lll to schedule ll

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59. 2-Methyl AP-237, a new synthetic opioid available via the black market

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Background: 2-Methy-AP-237 (2-MAP) is a derivative of AP-237 (Bucinnazine), was synthesized in Japan in 1968. 2-MAP is a potent opioid analgesic. This product is used in China to treat pain in cancer patients. According to the SAFETY DATA SHEET 2-MAP was not intended for human consumption and warns against any exposure route. This medication is not prescribed in the United States. 2-MAP is a new abused synthetic opioid that is categorized as a Novel Psychoactive Substance (NPS) that can be purchased on the black market via the internet.
Case report: We present a case of a 24 y/o male that was found unresponsive by his mother at home. Emergency services were called and EMS was activated. Emergency technicians found the patient unresponsive and hypoxic. Naloxone was administered and the patient regained consciousness, and was transported to the emergency department. The institution's toxicology protocol was followed that included the following laboratory studies CBC, CMP, UDS, acetaminophen and salicylate level, an EKG was done. The urine drug screen was negative; 2-MAP is not detected by the urine drug test available in the United States. The Emergency Department physician consulted with the Poison Center. The patient remained conscious and vital signs are as follows: BP: 119/63, P: 85, R: 17, T: 98.0, SATs: 94% on RA. The cardiac monitor was showing normal sinus rhythm. The physician requested information such as mechanism of action, kinetics, observation period, antidote, etc., on the drug 2-methyl AP 237 or Bucinnazine, (2-MAP), no information was found in Poisindex. Based on the limited information available the toxicologist recommended symptomatic and supportive care and naloxone if the patient became respiratory depressed with re-evaluation after an extended period of observation. The patient was admitted for medical observation.
Discussion: The only information found on 2-MAP was from Wikipedia which described 2-MAP as an agonist of mu-opioid peptide receptor. 2-MAP is a potent synthetic opioid, one of the most potent compounds among a series of analgesic acyl piperazines. 2-methyl-AP-237 is sold on the black market and classified as a "designer opioid". There are five different schedules of controlled substances as described by the United States Controlled Substance

Act. The 5 schedules are based on potential for abuse, accepted medical use, and the potential for addiction. Scheduled III substances are categorized as having a moderate to low potential for abuse, and schedule II have a high potential for abuse and dependence. 2-MAP is not prescribed in the United States and not recommended for human consumption by safety data sheet.
Conclusion: We reported on a new synthetic opioid agent categorized as NPS. 2-MAP is not detected in the standard urine drug screen making it difficult to diagnose. Toxidromes in this case provided health care providers with a tool to ascertain the plausible agent causing the symptoms and develop a treatment plan.

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60. High incidence of accidental ingestions of boric acid vaginal suppositories

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Background: Bacterial vaginitis (BV) is the most common vaginal condition in women ages 15-44, it is estimated that 29% of women in the United States of that age group are affected. Secondary to BV is vaginal candidiasis which accounts for 1.4 million outpatient visits annually.
Boric acid has anti-fungal and antiseptic properties and has been used for over 100 years for the treatment of vaginal infections. It is an inexpensive, easy to use, easily accessible treatment of vaginal infections, and does not require a physician's visit. The product is heavily marketed on social media sites and widely sold on-line. Most preparations sold on-line or over the counter are no longer in the bullet shaped wax and glycerin mixture; most are formulated in a 600 mg hard capsule.
The Food and Drug Administration estimates that 1.5 million people are injured by medication errors annually in the U.S... According to the Institute of Medicine (IOM) medical errors are the eighth leading cause of death in the United States, the report identified medication errors as the most common type of error in health care. Medication errors at home occur at rates of between 2-33%.
Poison control centers manage phone calls concerning medication errors; including wrong route administration and adverse drug reactions from patients, caregivers, and healthcare professionals. This study will evaluate the frequency of wrong route exposures / ingestion of boric acid vaginal suppositories over the last decade.
Methods: A retrospective data review from six regional Poison Centers in the United States was conducted over a ten year period to determine the number of boric acid vaginal suppositories exposures documented as wrong route exposures. Our search for data included all cases documented as wrong route exposures with boric acid vaginal suppositories with products coded as borate (excluding topical & insecticide) or boric acid vaginal suppository (antiseptic excluding insecticide).
Results: Boric acid vaginal suppository wrong route exposures documented from our multi center survey are as follows: in 2011-15 cases were documented, in 2012-23 cases, 2013-22 cases, 2014-17 cases, 2015-21 cases, 2016-18 cases, 2017-20 cases, 2018-44 cases, 2019-110 cases, and 2020-280 cases were documented. During the surveyed 10 year period boric acid vaginal suppository wrong route exposures has increased exponentially.
Conclusions: Product design can be a contributing factor in wrong route exposures. The appearance of the medication may serve as a valuable safeguard against medication errors. The bullet or torpedo shaped suppository form as opposed to a gel capsule would likely decrease wrong route exposures.

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61. Inadvertent non-treatment of a toxic methanol level from contaminated hand sanitizer ingestion without serious adverse effect

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Background: Ingestion of hand sanitizer as an alcohol substitute in patients with alcohol use disorder has become increasingly risky during the COVID-19 pandemic, as multiple brands have been contaminated with methanol. Methanol intoxication can cause CNS and respiratory depression, high anion gap (AG) acidosis with life threatening cardiopulmonary effects, risk of death and permanent blindness. Methanol poisoning may occur even with ingestion of small quantities. Unfortunately methanol testing is not readily available at many health care facilities (HCF) leaving providers and poison centers (PC) to use surrogate metabolic testing and clinical judgement to make treatment decisions. We present a case of methanol poisoning where use of serum bicarbonate and anion gap did not detect a treatable methanol concentration.
Case: A 50-year-old man presented to the emergency department (ED) approximately 4 hours after consuming up to 4 oz of hand sanitizer (Art Naturals brand hand sanitizer) for the purpose of intoxication when ethanol became unavailable. The Poison Center at the time of presentation was concerned for possible methanol contamination and recommended laboratory monitoring; serial BMP and ethanol levels. He was awake, alert and ambulatory with only nausea and vomiting. His initial laboratory findings revealed AG 17 with CO2 19, Na 123 and K 3.3 and a negative serum ethanol. His repeat labs at 10-hours and 12-hours post ingestion improved following fluid resuscitation with vitamin/electrolyte supplementation. It was felt that it was not likely for him to have consumed a methanol-contaminated hand sanitizer product as his lab results were consistent with a chronic alcoholic after recent alcohol consumption, and symptoms and laboratory improvements were observed after supportive cares. He was discharged to home. The Poison Center and subsequent shift provider were unaware that a methanol level was sent and it eventually returned 72-hours later (70 mg/dL). Follow up with the patient at home was established later that day at approximately 4 days post exposure. The patient reported he was doing well with good vision and no complaints. On a subsequent home follow-up the patient did endorse burning in the stomach and some slightly blurred vision with trouble with fine details, but otherwise doing well.
Discussion: The patient was discharged prematurely given a low suspicion for ingestion of a methanol-contaminated hand sanitizer due to his history and workup, but a timely methanol lab reporting would have resulted in fomepizole therapy. Fortunately this patient survived his methanol ingestion with minimal sequelae.
Conclusion: This case report suggests that methanol levels up to 70mg/dL may not be as severely toxic as previously thought. It also illustrates that closing anion gap might not be sufficient to rule out a possible methanol ingestion in the absence of timely methanol level testing.

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62. Adulteration of illicit drugs in ED patients with acute opioid overdose: a multicenter cohort

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Background: Many illicit opioids contain adulterants that are potentially harmful. We describe analytically confirmed adulterants present in a cohort of ED patients presenting after an opioid overdose.
Methods: This case series includes adult ED patients who presented after a suspected opioid overdose to an emergency department at a participating site in the American College of Medical Toxicology's Toxicology Investigators Consortium (ToxIC) fentalog study group between 10/6/20-3/9/21. Case exclusion criteria were unavailable specimens, non-toxicological alternate diagnoses (trauma, burns, sepsis), prisoners, and children <18. Participating sites include 5 facilities in 4 States (Pennsylvania, Missouri, New York, and Oregon). Discarded blood samples were collected and toxicological confirmation was performed via liquid chromatography quadrupole time-of-flight mass spectrometry for the presence of over 900 psychoactive substances and their metabolites, including adulterants. Patients included in this analysis were positive for at least one adulterant upon toxicological confirmation.
Results: Out of 760 patients screened, 81 met inclusion criteria; the median (IQR) age was 36 (34-49) years and the majority were men (59; 72.8%). Of the 81 samples tested, 61 contained illicit opioids Only 4 (4.9%) of the 61 lacked adulterants. Adulterants present are summarized in the Table, and included quinine (41; 50.6%), levamisole (25; 30.9%), xylazine (16; 20%), lidocaine (16; 20%), phenacetin (13; 16%), and diphenhydramine (12; 14.8%). Phenacetin was primarily confined to samples from Pennsylvania, whereas levamisole, lidocaine, and xylazine were located in Pennsylvania and Missouri. Quinine was present from samples in all four states. While most samples that tested positive for either phenacetin or levamisole had the presence of cocaine, 4 out of 25 (16%) samples that contained levamisole lacked any evidence of cocaine.
Discussion: In this cohort, adulterants were widespread, even though there was geographic variation. While this analysis was not designed to evaluate toxicity from the adulterants specifically, it is possible that toxicity occurs. Quinine is a 1a anti-arrhythmic, and is associated with nausea, vomiting, hypoglycemia, thrombocytopenia, and cinchonism (tinnitus, blindness, and dizziness). Phenacetin is associated with renal failure with papillary necrosis, oxidant stress, and is a probable carcinogen. Levamisole is associated with agranulocytosis and vasculitis with disfiguring skin necrosis. Xylazine is a phenothiazine used in veterinary medicine as a sedative, and its toxicity includes severe hypotension and CNS depression. Lidocaine is a local anesthetic associated with seizures and arrhythmias in high doses. Diphenhydramine has been associated with urinary retention, delirium, as well as other antimuscarinic symptoms, seizures, and arrhythmias.
Conclusion: In this cohort, adulterants were detected often in the blood samples of patients with illicit opioid overdose, and variations of adulterants were based on the specific opioid as well as geographical region. The most consequential adulterants physicians should be aware of include phenacetin, quinine, levamisole, and xylazine.

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63. Patterns of selective serotonin reuptake inhibitor exposures reported to the US poison centers

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Background: More than 20 million antidepressants were prescribed in the U.S. between October and December 2020, a significant increase compared to the same months in the prior year. We sought to characterize the SSRIs exposures reported to the U.S. National Poison Data System (NPDS).
Methods: The NPDS was queried for all human exposures to selective serotonin reuptake inhibitors (SSRIs) reported to the U.S. Poison Centers (PCs) between 2015 and 2020. We descriptively assessed the demographic and clinical characteristics. Calls from acute care hospitals and hospital based EDs (ACH) were studied as a subgroup. Trends in SSRI exposures were analyzed using Poisson regression with percent changes being reported.
Results: There were 346,082 SSRI exposure calls made to the PCs from 2015 to 2020, with the number of calls increasing from 51,791 to 62,504 during the study period. Single substance exposures accounted for 45.5% of such SSRI exposures. Of the total SSRI calls, the proportion of calls from ACHs decreased from 56.2% to 53.2% from 2015 to 2020. Multiple substance exposures accounted for 65.5% of the overall SSRI calls from ACHs. Approximately 15% of the patients reporting SSRI exposures were admitted to the critical care unit (CCU), with 18.8% patients admitted to a psychiatric unit. Residence was the most common site of exposure (94.2%), and 63.9% of these cases were enroute to the hospital via EMS when the PC was notified. Among the patients, 66.7% were male, with individuals between ages 13 and 19 years (31%) predominantly reported SSRI exposures. Suspected suicides (58.5%) and therapeutic errors (18.6%) were commonly observed reasons for exposure, with the former accounting for 83% cases reported by ACHs. Major effects were seen in 3.7% cases and the case fatality rate for SSRI was 0.3%. Sertraline was the most commonly observed SSRI (23.6%). The most frequently co-occurring substances associated with the cases were atypical antipsychotics (9.3%) and benzodiazepines (8%). Tachycardia (19.7%) and drowsiness/lethargy (15.6%) were the most commonly observed clinical effects. During the study period, the frequency of SSRI exposures increased by 19.9% (95% CI: 16.2%, 22.7%; $p < 0.001$), and the rate of SSRI exposures increased by 23.1% (95% CI: 15.2%, 29.2%; $p < 0.001$).
Conclusion: There was a significant increase in the reports of SSRI exposures during the study with sertraline being the most commonly reported SSRI. Suspected suicides was the most common reason for exposure.

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64. National estimates of hallucinogen-related poison center calls

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Background: In 2019, a total of 70,630 drug overdose deaths occurred in the United States, an age-adjusted rate of 21.6 per 100,000 population and a 56.5% increase from 2013. In 2018, approximately 1.6 million persons in the United States aged 12 or older were categorized as current hallucinogen users. The objective of our study was to evaluate the trends in hallucinogen-related calls to the U.S. poison centers (PCs).
Methods: The National Poison Data System (NPDS) was queried for all closed, human exposures to hallucinogens from 01/01/14 through 12/31/20 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 hallucinogen 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 18,729 toxic exposures to hallucinogens that were reported to the PCs. The frequency of exposures decreased by 46.3% (95% CI: - 54.5%, - 36.5%; $p < 0.001$), and the rate of exposures decreased by 45.3% (95% CI: - 53.8%, - 35.9%; $p < 0.001$). Of the total hallucinogen calls, the proportion of calls from ACHs increased from 68.3% to 74.8%, with the percentage of calls from the general public decreasing. Multiple substance exposures accounted for 44.4% of the overall hallucinogen calls and 50% of calls from ACHs. Approximately 19% of the patients reporting hallucinogen exposures were admitted to the critical care unit (CCU), with 7% of patients being admitted to a psychiatric facility. Residence was the most common site of exposure (76.3%), and 81% of these cases were enroute to the hospital via EMS when the PC was notified. Cases were predominantly male (67.1%), with the most common age group being 13-19 years (37.6%). The proportion of such cases (38.7% to 54.1%) increased during the study period. Intentional abuse (70.1%) was 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 hallucinogen abuse exposures decreased (75.5% to 69.3%), while suspected suicides increased (8.6% to 14.2%). Major effects were seen in 8.2% cases and there were 126 deaths reported, with 10 fatalities reported for single substance hallucinogen 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 decrease in the reports of hallucinogen exposures made to the PCs. The exposures in the teen age group 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 hallucinogen exposures.

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65. Severe medical outcomes due to single substance opioid exposures

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Objectives: 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 United States (U.S.) in 2019, with 49,068 involving an opioid. The present study sought to evaluate the recent trends in the severe outcomes to single substance opioid (SSO) exposures reported to the U.S. poison centers (PCs).
Methods: The NPDS was queried for single substance opioid exposures from 2011 to 2018. Cases with severe outcomes (SO) were defined as exposures that resulted in either a death or major clinical outcomes. We identified and descriptively assessed the relevant demographic and clinical characteristics. Poisson regression models were used to evaluate the trends in the number and rates (per 100,000 human exposures) of SSO exposures resulting in SO. Percent changes from the first year of the study (2011) were reported with the corresponding 95% confidence intervals (95% CI). Logistic regression was utilized to study the risk markers of severe outcomes.
Results: Overall there were 308,202 SSO-related cases reported to the U.S. PCs during the study period. The proportion of cases from acute care hospitals and emergency departments (ACH) increased during the study period (32.9% vs 48.9%). Among cases with severe outcomes, ages between 20 and 29 years (27.9%) constituted the most common age group. Males accounted for 57.4% cases. Most exposures with SO occurred in a residence (83.7%). Hydrocodone (25.6%) was the most common opioid reported in cases followed by oxycodone (18.7%). Intentional abuse (48.4% vs 12.7%) and suspected suicides (24.7% vs 12.9%) were more common in exposures with SO. Similarly, non-oral routes of administration were more common in exposures with SO (40.9% vs 8.1%). The rate of exposures with SO increased by 71.3% (95% CI: 63.4%, 79.9%, $p < 0.001$). The risk of SO with SSO-related exposures was the highest in cases between 50 and 59 years of age (Ref: 20 – 29 years) (AOR: 1.61, 95% CI: 1.52 – 1.71). Males were 16% more likely than females to have serious outcomes (AOR: 1.16, 95% CI: 1.12 – 1.20). The risk for severe outcomes with SSO exposures was significantly elevated in hydrocodone (AOR: 2.43, 95% CI: 2.30 – 2.58), oxycodone (AOR: 1.64, 95% CI: 1.55 – 1.73) and tramadol (AOR: 1.80, 95% CI: 1.69 – 1.92) exposures. Other Important predictors of a SSO-related SO were suspected suicides (Ref: Unintentional exposure) (AOR: 3.82, 95% CI: 3.67 – 4.09), non-oral routes of administration (Ref: Ingestion) (AOR: 2.94, 95% CI: 2.80 – 3.00) and exposure in the west census region of the U.S. (Ref: Northeast region) (AOR: 1.21, 95% CI: 1.16 – 1.28).
Conclusions: The number of SSO exposures cases decreased, but those with severe outcomes increased significantly. Hydrocodone and oxycodone were the most common opioids reported for the sample. Personalized evidence-based strategies, population level interventions, creation of protective environments, and better screening of patients are some key measures to consider for the future to limit this trend.

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66. Feel the sting: the buzz on wasping and abuse of processed pyrethroids

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Background: "Wasping"—the intentional use of pyrethroid insecticides as a drug of abuse—may sound like a novel practice, but it has been described as early as 1982. Most documented cases of exposures are limited to mild symptoms or local injection site reactions. Severe systemic toxicity is uncommon, and documented fatalities are even rarer. Deaths associated with pyrethroid ingestion and inhalation have been reported, but deaths associated with injection have not been documented. We describe a unique poison center case of a 29-year-old female with a history of seizures attributed to chronic methamphetamine use, who injected crystallized Raid as an alternative to methamphetamine.
Case report: The patient presented to the Emergency Department (ED) for progressively worsening dyspnea, lethargy, and confusion after injecting crystallized pyrethroids. She was promptly intubated for hypoxemic respiratory failure and admitted to intensive care for multiorgan failure including heart failure with bilateral pleural effusions and acute hepatic failure with transaminases >9000 U/L, INR of 3.6, and platelets <51 x10^9/L. She developed new-onset renal failure (K 6.6 mmol/L, BUN 37 mg/dL, Cr 3.4 mg/dL). Vasopressors for refractory hypotension and a sodium bicarbonate infusion for acidosis were administered. Renal failure persisted despite continuous renal replacement therapy and hemodialysis. Hepatic failure worsened despite N-acetylcysteine treatment. After further clinical deterioration she was successfully resuscitated following a brief cardiac arrest, then transitioned to comfort care and died nine days after presentation. The frequency, chronicity, and quantity of our patient's pyrethroid abuse remain unknown.
Discussion: Several cases of systemic toxicity from intravenous pyrethroid abuse are documented. One case describes status epilepticus in a 44-year-old male after injecting 3-4 millilters of cypermethrin 1.2% into his inguinal area. Another case describes hypoxia and sub-pleural consolidations on computed tomography after a 30-year-old female injected 5-7 millilters of prallethrin 1.6% into her wrist. Liver failure and altered mentation were described in a 56-year-old male after injecting crystallized pyrethroids; however, he was later found to be positive for hepatitis A and B.
Reported deaths from pyrethroid exposures are rare. A 45-year-old male presented to the ED for nausea, vomiting, and diarrhea after consuming food contaminated with cypermethrin. He developed seizures and died from cardiac arrest three hours later. Reported deaths from intentional abuse of pyrethroids are even less common. A 29-year-old male presented in respiratory distress after smoking synthetic marijuana laced with pyrethroids; he developed respiratory failure and died from cardiac arrest.
Pyrethroid insecticides cause hyperexcitation via delayed sodium channel closure at lower concentrations, and antagonism of GABA-mediated chloride channels at higher concentrations, which may account for the sympathomimetic "high" sought with abuse of pyrethroids. Pyrethroid insecticides contain toxic solvents including cyclic, aromatic, and halogenated hydrocarbons, in addition to other reportedly inert propellants and corrosion inhibitors. The additional "inert" components may have contributed to this patient's multiorgan failure and subsequent death.
Conclusion: Systemic toxicity after intentional abuse of pyrethroids is uncommon, and fatalities are rare. Intentional ingestion or inhalation are rarely associated with fatalities, and death associated with intravenous abuse has not been reported. We describe a case of intravenous abuse of a crystallized pyrethroid insecticide associated with death.

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67. Implementing comprehensive screening of non-fatal overdoses treated at the University of Kentucky Emergency Department

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Background: Routine drug testing provides limited value for initial clinical treatment of overdoses and is rarely ordered by ED physicians in favor of symptomatic and supportive care. Lack of confirmatory testing leads to the inability to track the involvement of substances in non-fatal overdoses, thus further impacting ICD 10 coding documentation. To complicate this, many synthetic substances are not detectable utilizing common laboratory testing.
This is a pilot study exploring an innovative approach for comprehensive drug testing of non-fatal overdoses in ED and allows for the capture of missing information and identification of novel synthetic drug involvement. This additional information will improve diagnostic coding (and administrative billing records) involving overdoses. This study hopes to show the benefits of such comprehensive and routine testing and it's potential impact on public health response to the opioid drug epidemic. This project is part of the Kentucky Overdose Data to Action Proposal in response to the CDC funding opportunity CDC-RFA-CE19-1904.
Methods: In addition to the workflow of the implementation of novel testing, the primary objective is to identify patterns of substance abuse. Secondary objectives include the severity of symptoms, potential treatment guidelines, utilization of health care resources, morbidity, and mortality. Additionally, concordance between involved substances based on toxicology testing and involved substances identified by the ICD-10-CM discharge diagnoses.
Patients are identified as a suspected or potential overdose by the health care team. Once identified, an order was placed notifying the laboratory to secure and save any leftover samples of blood and/or urine for further analysis. A retrospective record review will be performed for collection of demographic data and suspected overdose type. This study was designed not to interfere with routine medical care. Any research testing performed was not included in the patient's medical record. Drug screen testing was performed via gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-tandem mass spectrometry (LC-MS/MS). Further testing will be pursued for patients with clinical discrepancy between clinical presentation and laboratory findings.

Results: Study enrollment, data collection, and analysis is ongoing. Currently, 304 patients have been identified since April 15, 2021. The population is 60.3% male, average age of 34.8 years. Opioids were the most commonly suspected agent involved (42.5%), 21.9% of exposures were unknown in nature. 159 of the patients have had drug testing competed. 12 cases were identified as potential exposure to a novel agent not detectable by routine hosptial testing and will be analused for further analysis.
Conclusions: This project aims to develop a process to make drug screening more valuable and comprehensive in era of the narcotic epidemic. With more extensive testing for synthetic and novel drugs, the more decrete data will be available to improve understanding, management and prevention methods against the overdose epidemic.

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68. Methamphetamine and rhabdomyolysis: a poison center retrospective study

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Background: Rhabdomyolysis is an adverse effect sometimes associated with stimulant use reported to US poison centers. The purpose of this study was to identify trends in the incidence of rhabdomyolysis reported with methamphetamine use compared to other stimulants.
Methods: The electronic medical record (EMR) for a state-wide poison center serving a population of approximately 5 million people was queried for cases in a 5-year period reported between 01/01/2016 and 05/11/2021. Subjects were identified by searching for single xenobiotic exposures under the American Association of Poison Control Centers (AAPCC) major substance category *Stimulants and Street Drugs*. These cases were subsequently analyzed to identify those with rhabdomyolysis coded as an effect. *National Poison Data System (NPDS) Coding Users' Manual v3.2* defines rhabdomyolysis as creatine kinase (CK) > 500 IU/L and/or myoglobinuria. Methamphetamine exposures were subsequently compared to other stimulants including amphetamines, cocaine, ephedrine, kratom, LSD, mescaline/peyote, synthetic compounds, and methylphenidate. Cases coded under the *Diet Aids* subcategory were excluded, along with amyl or butyl nitrites, caffeine, cannabidiol (CBD), marijuana and marijuana-containing e-cigarettes, GHB analogs or precursors, other hallucinogens, other street drugs, and unknown stimulants or street drugs. Results where then analyzed with chi-squared test to determine statistical significance.
Results: 2584 subjects were identified as meeting the inclusion criteria above. Of the 439 cases involving methamphetamine, 25 developed rhabdomyolysis (5.69%). Of the other 2145 stimulant cases reviewed (excluding methamphetamine), 18 developed rhabdomyolysis (0.84%). Breakdown of other stimulants included: amphetamines (excluding methamphetamines), n= 1242, 5 cases of rhabdomyolysis; methylphenidate, n = 588, rhabdomyolysis =0; synthetic cannabinoids, n = 124, rhabdomyolysis =5; cocaine, n = 86, rhabdomyolysis =2; LSD, n = 34, rhabdomyolysis =1; kratom, n = 24, rhabdomyolysis =0; synthetic cathinones, n = 18, rhabdomyolysis =4; synthetic phenylethylamines, n = 17, rhabdomyolysis =1. All other substances had 10 or less cases identified. Subjects exposed to methamphetamine were more likely to develop rhabdomyolysis compared to other stimulants, X^2 (1, n= 2584) = 52.5, $p = < .00001$. This result was significant at $p < .05$.
Discussion: In this small single poison center analysis, methamphetamine was associated with a higher incidence of rhabdomyolysis as compared to other stimulants as defined by the AAPCC. Several limitations existed including: no confirmatory testing was done on subjects, rhabdomyolysis was defined as CK >500 I/U and/or myoglobinuria which may not be clinically significant, and our results were underpowered to test methamphetamine against other individual stimulants.
Conclusion: This study suggests that the incidence of rhabdomyolysis is higher with methamphetamine exposure than with other stimulants. Health care providers may consider screening patients who are exposed to methamphetamine for rhabdomyolysis. Further longitudinal studies required to elucidate a true causation.

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69. A rapid progression: dapsone hypersensitivity syndrome leading to multi-organ failure

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Background: Dapsone (4,4'- diaminodiphenylsulfone) is utilized clinically for the treatment of a variety of dermatologic and infectious conditions. Dapsone has classically been associated with methemoglobinemia and hemolytic anemia, however more sinister toxicities have been described.
Case report: A 47-year-old woman presents with hypoxemia and leg pain. Her medical history is notable for Crohn's disease and pyoderma gangrenosum. She was initiated on dapsone three months prior to presentation with the dose increased from 100mg to 150 mg by mouth daily one month prior. Prior to initiation, her G6PD activity was confirmed. She denied other symptoms, including palpitations, dyspnea, cough, and hemoptysis. Vital signs were notable for HR 105bpm, SpO2 88%. Exam demonstrated a well appearing female in no acute distress, breathing comfortably, clear lungs, normal heart sounds with regular tachycardia. Right leg had large ulcerations that were mildly purulent and malodorous. A pustular erythematous rash was noted on bilateral lower extremities. Initial labs with normal renal function, WBC 1.92 10^3/microL, (ANC 880, 2% eosinophils), HGB 9.0 g/dl, and PLT 139 10^3/microL. No evidence of hemolysis on peripheral smear. CT angiography revealed a segmental pulmonary thrombo-embolus and a small area of consolidation. An arterial blood gas was obtained which revealed a PaO2 of 215 mmHg, methemoglobin level 9%. Dapsone was held. Hours later, the patient developed worsening hypoxemia despite 100% FiO2. HR increased to 150s. She was febrile (103F) and hypotensive requiring norepinephrine infusion. Cyanosis and jaundice were noted on exam. Labs drawn at time of event demonstrated lactic acid 7mmo/L, bilirubin 14 mg/dl(direct predominance), PaO2 145 mmHg. IV methylene blue was administered with brief interval improvement, however patient mentation worsened, necessitating endotracheal intubation. Stress dose steroids were initiated. Abdominal ultrasound revealed an enlarged, steatotic liver. Over the next 48 hours, the patient's condition improved with improved hyperbilirubinemia and patient was successfully extubated.

Discussion: Dapsone hypersensitivity syndrome (DHS) was first described by Allday, Lowe, and Barnes as a hypersensitivity vasculitic syndrome. It is characterized by the classic triad of fever, dermatologic eruption, and internal organ involvement. Typical onset is 2-6 weeks after initiation. Mortality has been described as high as 9.9%, incidence of DHS has been reported in 1.4% patients started on dapsone. In terms of organ involvement, our patient demonstrated pancytopenia, pneumonitis, cholestatic liver injury, shock, and encephalopathy. Interestingly our patient's liver injury was largely cholestatic with no evidence of obstruction on imaging. Pre-clinical studies have demonstrated impaired bile flow from dapsone, leading to cholestasis and cholangitis. Other cases have described hemolytic anemia, eosinophilia, and lymphadenopathy complicating this disease picture. Resolution may be delayed as dapsone accumulates in peripheral tissues.
Conclusion: We present a case of dapsone hypersensitivity syndrome with severe multi-organ manifestations. Our case is particularly striking given the rapid in-hospital progression with frequent monitoring parameters to follow its evolution. Our patient walked into the Emergency Department with a dermatologic complaint and was otherwise asymptomatic. Within hours she required ICU-level management for respiratory failure, shock, and severe cholestatic liver injury.

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70. Toxicologic exposures in transgender patients during the SARS-CoV2 pandemic

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Background: About 0.3% of Americans identify as transgender (male-to-female, female-to-male and gender nonconforming). In the 2019 Toxicology Investigators Consortium (ToxIC) Registry annual report, 0.8% of cases involved transgender patients. There are many hypotheses as to why transgender patients may experience disparities in the healthcare system including but not limited to: stigma, lack of healthcare providers' awareness, and insensitivity. The COVID-19 pandemic has had multiple effects leading to worsening bio-psycho-social effects, such as isolation, decrease in social support structures and an increase in stressors. Therefore, the purpose of this study was to characterize cases reported in the ToxIC database involving transgender patients before and during the COVID-19 pandemic.
Methods: This is a retrospective database analysis reviewing cases involving transgender patients from 2017 to 2020. Cases during the year of 2020 were considered to be during the COVID pandemic. Inclusion criteria were: all ages, transgender sex, single- and multi-agent exposures, acute or chronic ingestions. Variables investigated included the frequency of exposures, intent or reason for exposure, type of exposure, and severity of (i.e, more ICU encounters, more treatments rendered). Descriptive statistics were performed to describe types of exposures, rates of hospitalization, and outcomes.
Results: A total of 195 cases involving transgender patients were reported to the ToxIC registry between 2017 and 2020. The total number of cases involving transgender patients continually climbed over the 4-year period: case numbers were 36 in 2017, 40 in 2018, 57 in 2019, and 62 in 2020. The youngest recorded case was 10-years-old and the oldest was 76-years-old, and median age was 18. Female-to-male gender identity was most common (n = 120, 62%), followed by male-to-female (n = 64, 33%) and gender-nonconforming (n = 11, 6%), most patients were in the 13-18 year-old age group. Caucasian was the most frequently identified race. Intentional pharmaceutical overdose was the most common reason for toxicology consult, with attempt at self-harm being the primary reason, for all year. Analgesics and antidepressants were the most common xenobiotic exposure for all years. Overall, 45% of encounters were in the emergency department. Encounters in a floor (29%) or ICU (24%) were similar and did not differ between years. Some form of treatment was given in 66% of cases. The percentages of cases where treatment was given were 64%, 70%, 60%, and 71% for each individual year, respectively. Antidotal treatment was more frequent in 2020, and the most used antidote was N-acetylcysteine.
Conclusion: There is a trend of increasing number of cases of exposure involving transgender patients between 2017 and 2020. There is not a significant change in the reason for encounter between years. This is similar for location of consultation and rates of treatment. Despite potential worsening bio-psycho-social effects of the COVID pandemic, there did not appear to be a significant change in frequency, severity, or reasons of toxic exposures in transgender patients beyond the already concerning growing trend overall. Regardless, given the increasing trend additional awareness, support, and targeted resources for this population group will grow increasingly important.

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71. Prescription vs illicit opioid abuse among healthcare workers seeking addiction treatment

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Background: Opioid abuse remains a serious public health problem within the United States. Though some data sources indicate abuse of prescription opioid medications has declined, some subpopulations remain at increased risk for misusing these medications. Healthcare professionals (HCPs) may be of concern due to factors such as high-stress jobs and greater access to controlled prescription opioids. In addition, findings suggest that 10-15% of HCPs in the US will experience a substance use disorder in their lifetime. Recent approvals of opioid medications such as DSUVIA (sufentanil), which are only available in hospital settings, highlight the need for effective surveillance of opioid abuse by HCPs.
Methods: This study examined the association between HCP status and primary opioid abused among individuals enrolling in treatment for an opioid use disorder (OUD). Data from the Researched Abuse, Diversion and Addiction-Related Surveillance (RADARS®) System Treatment Center Programs Combined were used. Individuals age 18 years or older entering treatment programs for OUD completed anonymous questionnaires asking about prescription and illicit opioid abuse behaviors. HCPs were defined as respondents who indicated on the questionnaire that they were working as a healthcare professional providing direct patient care. A respondents' primary drug of abuse, the outcome variable of interest, was the prescription or illicit opioid used to get high the most prior to entering treatment. Endorsements of heroin or fentanyl were categorized as illicit opioids, endorsements of oxycodone, hydrocodone, hydromorphone, morphine, oxymorphone, methadone, buprenorphine, tramadol, tapentadol, or sufentanil were categorized as pharmaceutical opioids. A chi-

square test was used to analyze the relationship between HCP status and primary drug of abuse.
Results: Of the 23,146 respondents included in this study, 1,051 respondents (4.5%) were HCPs. The distribution of primary drug of abuse endorsements was significantly different between HCPs and non-HCPs ($p = 0.011$). Among HCPs, 42.3% ($n = 135$) indicated that a pharmaceutical opioid was their primary drug of abuse, 43.0% ($n = 137$) indicated an illicit opioid was their primary drug of abuse, and 11.9% ($n = 38$) indicated using both a pharmaceutical and illicit opioid as their primary drug of abuse. Among non-HCPs, 34.8% ($n = 1,789$) indicated a pharmaceutical opioid was their primary drug, 52.4% ($n = 2,694$) indicated an illicit opioid was their primary drug of abuse, and 10.3% ($n = 532$) endorsed both a pharmaceutical and illicit opioid as their primary drug of abuse.
Conclusion: A greater proportion of HCPs enrolling in treatment for OUD reported primarily abusing prescription opioids compared to other respondents. However, a large proportion of HCPs reported illicit opioids as a primary drug. Further studies are necessary to assess the association between exposure and access to medications and OUD among healthcare professionals.

DISCLAIMER
The RADARS® System is the property of Denver Health and Hospital Authority, a political subdivision of the State of Colorado. The RADARS® System is supported by subscriptions from pharmaceutical manufacturers, government and non-government agencies for surveillance, research and reporting services. Subscribers do not participate in conception, data collection, analysis, drafting, or interpretation of this abstract.

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72. Do poison centers contribute to risk identification for opioid overdose deaths?

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Background: Opioid overdose has been recognized as an epidemic, accounting for the large majority of prescription drug overdoses in the United States. Mortality from prescription drug overdoses continues to be a public health concern. Tools and methods available to clinicians to predict patients at risk for opioid overdose include databases such as prescription monitoring programs (PMPs) and electronic medical records. Previously published and validated risk factors for opioid overdose death, including patient and prescription characteristics, are identifiable in such databases and, when combined, theoretically improve sensitivity in identifying opioid use leading to increased likelihood of overdose.
Objective: In this study, we used four databases (overdose reports from the Office of the Medical Examiner [OME], the electronic medical records of 2 academic hospitals, the state PMP, and the database of a regional poison center) to see if we can improve upon identification of risk criteria for opioid overdose and death.
Methods: Opioid-related deaths were identified from OME records. Retrospective reviews of the PMP, electronic medical records of two academic hospitals, and the database of a regional poison center were conducted using demographic data from the OME. The PMP was utilized to find specific risk factors which were then compared to risk factors from the EMR and those contained in the poison center database. PMP data collected included number of opioid and non-opioid prescriptions, number of providers, number of pharmacies, and morphine dose equivalents. Hospital EMRs identified coexisting medical and psychiatric illness, substance use disorder, sedative/hypnotic use, and methadone use, and number of emergency department visits, including chief complaints and prescriptions given. Poison center data identified only three patients in common and was insufficient for analysis.
Results: 438 individual patients were identified. 346 had records in the PMP. 263 had encounters in the electronic medical records. Although the PMP and EMR had distinct risk factors identified, the poison center database did not contain significant overlap to identify risk factors such as multiple calls, history of exposures, or use of an opioid assistance hotline.
Conclusions: We identified that the PMP and EMR contributed to risk identification for opioid overdose and death. PMP and EMR contained distinct risk factors. Unfortunately, in this study, the poison center database, although available 24/7, did not show any significant signal that could contribute to risk identification. This lack of signal may occur for multiple reasons: providers are comfortable treating opioid overdoses without poison center input, time required to call the poison center during active patient care, and ability to maintain anonymity when requesting assistance from the poison center. Laws that obligate providers to report opioid overdoses to poison centers may improve on identification of risk factors such as escalating severity of an individuals' overdoses, overdoses unrelated to opioids, or attempts to seek help for opioid use or dependence.

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73. Cannabis as a cause of seizures: a scoping review

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Background: Cannabis products containing high cannabinoid concentrations have become increasingly available in recent years. Exposure to cannabis products is associated with a broad range of adverse effects including seizures, which have been reported with increasing frequency in the literature. Cannabis' effect on seizure activity is an emerging topic that remains without general consensus and merits further inspection. This scoping review aims to summarize the existing literature on plant-based cannabinoid exposures as a potential cause of seizures.
Methods: A scoping review was conducted in accordance with the PRISMA Extension for Scoping Reviews guidelines. Two databases (PubMed and Scopus) were searched over a 20 year period. Inclusion criteria were: 1) original research articles, 2) inclusion of human subjects, and 3) either investigation of seizures as a part of recreational cannabinoid use OR of exogenous cannabinoids as a cause of seizures. Key data points were extracted using a standardized data abstraction tool.
Results: Our initial search identified 3,104 unique articles, which were screened for eligibility and exclusion criteria through a title and abstract review. This resulted in 68 articles that subsequently underwent full text review. A total of fourteen retrospective studies met criteria, including seven that focused exclusively on pediatric subjects (< 20 years of age), three that included only adult subjects, and four with combined adult and pediatric

populations. Eleven studies evaluated acute cannabis exposure and reported rates of seizure ranging from 0.51%-20%. Single-substance cannabis exposure was specified in eight of these studies. The aggregate total seizure incidence in these eight studies was 2.2% (n = 104/4,697), and only one study reported a rate of under 3%. The remaining 3 studies evaluated patients with a history of unspecified/chronic cannabis use. One study reported epilepsy to be the cause of hospitalization in 1.8% of recreational marijuana users, and another study reported a 56% higher odds of hospitalization for epilepsy in patients with cannabis use disorder. The final survey-based study of patients with epilepsy concluded that subjects perceived that active cannabis use had no significant effect on the disease.
Conclusion: Ten out of eleven studies reported higher rates of seizure incidence after acute cannabis exposure than would be expected based on epilepsy rates in the general population, using conservative estimates (range 0.7-1.2%). Applying the Naranjo criteria and WHO-Uppsala Monitoring Centre criteria to the available animal and human data, the causal relationship between cannabis product exposure and seizures is probable. The mechanism by which cannabis induces seizures is still unclear, but there is evidence to suggest that tetrahydrocannabinol (THC) is the causative xenobiotic. Future work should focus on establishing this causal relationship, whether cannabis is proconvulsant, epileptogenic, or both, and investigating the underlying pathophysiology.

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74. Severe cognitive dysfunction and muscle stiffness in the setting of chronic alcohol abuse: a case report of marchiafava-bignami disease

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Background: Marchiafava-Bignami disease (MBD) is a rare disorder characterized by degeneration of the corpus callosum associated with chronic alcohol abuse and malnourishment. Clinical manifestations include dementia, altered mental status, spasticity, dysarthria, ataxia, gait abnormalities, and seizures. Incidence of MBD is higher in men but does not vary with race or ethnicity. The mean age of onset is 45 years. Ethanol is a major risk factor for various brain disorders, and it is hypothesized that thiamine deficiency may directly damage the corpus callosum leading to necrosis.
Case report: A 45-year-old black female with hypertension, depression and a 20-year history of alcohol abuse presented to the emergency department with 6 months of progressive cognitive decline, decreased appetite, weight loss and recurrent ground level falls. Upon presentation, the patient had an inappropriate affect, was laughing on exam, and was responding to internal stimuli. She also had intermittent stiffness of upper and lower extremities and verbigeration.
Cerebrospinal fluid analysis did not show abnormalities. Magnetic Resonance Imaging (MRI) revealed a non-enhancing abnormal diffusion signal within the corpus callosum splenium. Patient was subsequently started on intravenous thiamine 300 mg/day, pyridoxine 50 mg/day and amantadine 100 mg/day. Repeat MRI revealed an improved but not completely resolved symmetric non-enhancing signal abnormality throughout the splenium of the corpus callosum.
After treatment with high dose thiamine, there was minimal improvement in her mental status.
She was oriented to self and could intermittently follow commands but her speech quickly devolved into nonsensical language. Her extremity stiffness did not improve and she was unable to walk.
Discussion: MBD is a rare and poorly characterized disease. It can be suspected in patients with chronic alcohol abuse or malnutrition who present with cognitive or neurological manifestations such as extremity stiffness, ataxia and depression. The management is supportive and similar to the treatment of Wernicke-Korsakoff syndrome. A review of 153 cases of MBD reported better outcomes among those who were treated with thiamine. Further, those who were given thiamine in the acute phase of the disease (within 2 weeks) did significantly better than those treated later or in the chronic phase. Treatment with thiamine ranged between 1 and 105 days. After adjustment for several confounders, delayed treatment with thiamine was the only significant risk factor for poor outcome. In our patient, while the interval improvement in MRI findings is reassuring, her late presentation ultimately delayed thiamine therapy.
Conclusion: MBD should be considered in patients who present with subacute neurologic decline and chronic alcohol use. Prompt recognition is key to initiating early thiamine therapy. Further research is needed to elucidate the pathophysiology and prognostic indicators associated with recovery.

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75. Bradycardia, hypotension, and hypothermia after delta-9-tetrahydrocannabinol poisoning

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Background: Poisoning by delta-9-tetrahydrocannabinol (THC) is typically associated with neuropsychiatric symptoms. In young children, intensive care monitoring may be required due to central nervous system depression with subsequent loss of airway protection. Such monitoring is rarely needed in late teenage or adult patients. Bradycardia with hypotension and hypothermia due to acute THC poisoning in adolescent or adult patients has not been reported in the literature.
Case report: A 17-year-old boy with a history of depression presented to an emergency department with slurred speech and somnolence. Prior to presentation, he demonstrated agitation, hallucinations, and ataxia. Ingredients on a cookie wrapper found in his bedroom listed 3000mg of THC distillate per package. It was presumed that the patient ingested the entire contents of the package. Initial vital signs showed heart rate 74 beats/minute and blood pressure 109/66mmHg with. Initial exam revealed 3mm reactive pupils and stupor only responsive to deep sternal rub. Soon after presentation, heart rate dropped to 35 beats/minute with blood pressure 82/53mmHg and oral temperature 34.4 °C. Electrocardiogram showed sinus bradycardia with rate 40 beats/minute, right axis deviation, and normal intervals. The patient was admitted to the intensive care unit. End tidal carbon dioxide monitoring showed normal values, and urine output remained >0.5mL/kg/h. Findings of stupor, bradycardia predominantly at 40 beats/minute, and hypotension responsive to fluid

boluses continued for 48 hours after estimated time of ingestion. Endotracheal intubation, atropine, and vasoactive medications were not required. Urine drug screen immunoassay was positive for cannabinoid only. Gas chromatography/mass spectroscopy showed cotinine and theobromine. Total delta-9-carboxy-THC metabolite measured in urine obtained 18 hours after ingestion measured >500ng/mL. Delta-9-tetrahydrocannabinol, 11-hydroxy-delta-9-tetrahydrocannabinol, and delta-9-carboxy-tetrahydrocannabinol metabolites in plasma obtained 36 hours after ingestion measured 8.0ng/mL, 6.8ng/mL, and 160ng/mL, respectively. Following clinical improvement, the patient admitted to recreational THC use and consumption of the entire contents of the cookie package. He denied intentional self-harm and co-ingestants. He was discharged home.

Discussion: THC intoxication in adolescent and adult patients rarely results in clinical symptoms requiring hospitalization or intensive care unit monitoring. Although central nervous system depression and tachycardia can be seen, symptoms of bradycardia, hypotension, and hypothermia have not been described in association with acute THC intoxication. Such hemodynamic findings are likely secondary to deep central nervous system depression following a massive ingestion of THC. Poor correlation exists between blood THC levels and clinical manifestations of intoxication.

As more states legalize recreational THC use, there are likely to be more inadvertent poisonings requiring hospitalization both for pediatric, adolescent and adult patients. Manufactures of THC-containing recreational edible products must be mindful of THC distillate concentrations. Users, young and old, may not decipher product use instructions, and subsequently, may be at risk for severe THC intoxication.

Conclusion: Following massive ingestion of THC, adolescent and adult patients may be at risk of significant bradycardia and hypotension as well as central nervous system depression. Such clinical findings may necessitate intensive care monitoring, similar to exploratory pediatric THC ingestions.

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76. Precipitated opioid withdrawal from a naltrexone-containing weight loss pill in a patient with chronic buprenorphine use

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Background: Naltrexone is a competitive mu opioid receptor antagonist increasingly used to treat substance use disorders, including opioid and alcohol use disorders. It is also marketed as an appetite suppressant, and FDA approved for weight loss in combination with bupropion. Prescribing information cautions against use in patients who are dependent on opioids or using a medication to help with opioid cessation. We present a case of precipitated opioid withdrawal in patient on buprenorphine/naloxone who took a weight loss tablet that contained naltrexone.

Case report: A 53-year-old male amateur bodybuilder with a history of chronic pain, opioid use disorder, and daily buprenorphine/suboxone use presented to the Emergency Department (ED) via ambulance with acute agitation, muscle cramping, nausea, and general malaise after taking a 10 mg naltrexone pill. He had been taking buprenorphine 8mg/ naloxone 2mg tid for >10 years after developing opioid dependency from management of chronic back and shoulder pain. He and his wife had ordered naltrexone online from a weight loss medication prescription service, and they both took their first-ever dose on the morning of presentation. 30 minutes after taking naltrexone, the patient began to feel anxious, nauseous, achy, and restless while driving to work, symptoms he had experienced previously when in opioid withdrawal. He called 911 from his workplace due to worsening symptoms, and on arrival to the ED, he was found to have a heart rate of 110-120/min, respiratory rate 27/min, and blood pressure 170/100 mmHg. On physical exam, he was anxious and diaphoretic, with repeated yawning and notable psychomotor agitation. A urine drug screen was negative for amphetamine, cocaine, and opioids. During his ED stay, he received diazepam and haloperidol for sedation and anxiolysis. His home buprenorphine/naloxone regimen was started several hours later, and by the next morning his vital signs had normalized, his symptoms completely resolved, and he was subsequently discharged home. His wife, who had taken the same naltrexone dose and was not opioid-dependent, remained asymptomatic.

Discussion: Buprenorphine is a partial mu opioid receptor agonist used to treat opioid use disorder and chronic pain, primarily in combination with naloxone. Buprenorphine has a high affinity for the mu opioid receptor, but it's effects in overdose can be reversed with naloxone at higher than typical doses. Naltrexone has higher receptor affinity than naloxone and would be expected to compete with buprenorphine at the mu receptor, causing withdrawal in buprenorphine-dependent patients. Our patient was unaware that his new weight loss medication contained an opioid antagonist, naltrexone, that could interfere with buprenorphine. He developed the rapid onset of symptoms consistent with severe precipitated opioid withdrawal requiring parenteral sedation and hospital admission.

Conclusion: Naltrexone can precipitate opioid withdrawal in patients chronically taking buprenorphine. The presence of naltrexone in FDA-approved and off-label weight loss medications may be unrecognized by patients and prescribers, and can lead to severe adverse effects when this interaction is overlooked.

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77. Serum CK trend as a predictor of rhabdomyolysis and renal failure in patients with sympathomimetic toxicity

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Objectives: Rhabdomyolysis and acute renal failure are two well-characterized complications associated with sympathomimetic toxicity. Serum creatinine kinase (CK) is frequently used to screen for these, but the predictive value of an initial serum CK level is unclear, particularly when it falls below the cutoff for rhabdomyolysis (which is typically defined as >5 times the upper limit of normal). We attempted to determine whether an initial CK value could be predictive of the development of either rhabdomyolysis or renal failure in emergency department patients with urine drug screen-confirmed sympathomimetic toxicity.

Methods: All patients presenting to a single county teaching hospital between January 2019-December 2020 were included in the analysis if (1) they had a CK level ordered in the ED and (2) they had a urine drug screen that was positive for either amphetamine, cocaine, or both. Initial and subsequent CK values,

along with initial and subsequent creatinine values, were recorded. Among those subjects with initial CK <1000 mg/dL, data were divided into quartiles and univariate analysis was performed to determine the odds ratio of progressing to CK >1000 mg/dL. A similar analysis was used to determine association between CK quartile and progression to renal failure (defined as Cr >2 mg/dL). Finally, we calculated the test characteristics of a dichotomous CK cutoff of 1000 mg/dL as a predictor for renal failure.
Results: A total of 94 subjects met inclusion criteria. 85.1% of these subjects were positive for amphetamine only. 27% of subjects required the use of restraints, and 67% went on to be admitted to either a medical or psychiatric ward. 23.4% of subjects had an initial CK >1000 mg/dL, and the median initial CK value was 264 mg/dL. Each quartile increase in initial CK value (for all initial values below 1000 mg/dL) conferred a non-statistically significant increase in odds of progression to CK >1000 mg/dL (OR =1.95, 95% CI =0.75, 5.04). Likewise, each quartile increase in initial CK value conferred a non-statistically significant increase in odds of progression to renal failure (OR 1.33, 95% CI =0.72, 2.43). Using CK >1000 mg/dL as a cutoff results in a sensitivity of only 40% (95% CI 12.2%-73.8%) and a negative predictive value of 91.7% (95% CI 82.7%-96.9%) for the development of renal failure.
Conclusions: Though there were trends towards an association between higher initial CK value and subsequent development of CK >1000 mg/dL or acute renal failure, these results were not statistically significant. An initial serum CK of <1000 mg/dL is a reasonably robust negative predictor for the development of renal failure in patients with sympathomimetic toxicity.

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78. People who use drugs are saving lives. Injectable naloxone rescue kits and syringe exchange services participants

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Background: Since equipping laypersons with naloxone rescue kits began over two decades ago, non-medical community members have saved thousands of lives. One of the most successful access points for placement of these kits is in the setting of syringe exchange. Partnerships that place naloxone directly in the hands of people who use drugs have demonstrated crucial strides in preventing preventable deaths, and give us frontline information about naloxone use in those most at risk and using the substances we often know the least about.
Objective: To describe the reported use of intramuscular (IM) injectable naloxone rescue kits (containing 0.4 mg/ml naloxone doses) within a population of layperson participants in multiple syringe exchange services(SES) programs.
Methods: Anonymous self-reporting of naloxone rescue kit use including: the number of 0.4 mg naloxone doses/vials used in an opioid overdose reversal, who it was used on, if EMS was called, and if the individual survived. Participant kits each contain two doses of 0.4 mg naloxone(single dose vials), two syringes, and instructions. SES participants were encouraged to obtain multiple kits. Reversal data was collected anonymously by trained staff of each SES and aggregated by the lead agency.
Results: 3,088 individual reports of naloxone rescue kit use were documented over 50 months (02/2017-04/2021), data points were obtained on 1356 of these reversals. Kits were furnished by one central agency to 5 community-based organizations(CBOs), and were provided to participants during SES outreach services. 98.7%(1339) of the reports described a successful reversal and survival. The reported use was on a friend/acquaintance(73%), self(10%), stranger(6%), family member(6%), spouse(1%), unknown(5%). One dose of naloxone(0.4 mg IM) was used to reverse an overdose in 30%(400) of the reports, two doses 51%(698), 3 doses 10%(135), 4 doses 6%(79), 5+ doses 2%(31), unknown doses 1%(15). There were 17 unsuccessful reversal reports during this time period using between 1-4 vials of naloxone. EMS was reportedly called 36%(323) of the time when a layperson kit was used in this setting.
Conclusions: Individuals participating in SES programs self-reported use of naloxone rescue kits that had been furnished to them. Over 98% of those who were administered layperson naloxone in the SES setting were reported to have survived. The majority of the reversals were on a friend/acquaintance, but also on family members, the participants themselves, and even strangers. Over 81% of the reversals were reported successful with 1 or 2 doses of 0.4 mg IM injectable naloxone. These results do not indicate that an increased dose of naloxone is required in rescue kits that equip laypersons. These results do suggest that individuals in the SES setting should have access to multiple kits or kits with at least 3-4 doses given that 64% of the reports did not include a call to EMS. Increased education about the role of EMS, enhancing Good Samaritan legal protections for those who call 911, and ensuring individuals in this setting have access to multiple kits/doses is recommended. People who use drugs are saving the lives of those around them. They are often the true first responders.

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79. Chronic pain – a pilot study examining risks and benefits of opioids

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Background: Opioid treatment for chronic pain has been a topic of major controversy in medicine. Rates of misuse of opioids in chronic pain patients have been reported to be as high as 21%. However, treating chronic pain is a difficult task. The CDC's recommendation is to begin chronic pain treatment with non-pharmacologic therapies and then escalate from there to pharmacologic treatments including opioids. The CDC also suggests that risks and benefits be discussed with patients prior to opioid initiation. Although there is information in the palliative care and cancer pain literature regarding potential benefits such as improved quality of life and degree of pain relief from opioids, little has been published about the benefit in the general chronic pain population. We evaluated data from an online pilot survey on the benefits and risks of opioid use in patients with chronic pain.
Methods: Adult online survey panel participants in the US were recruited to participate in the PAINRx Program survey from September through November 2018. Participants completed a self-administered anonymous web-based survey evaluating the overall benefits and risks associated with the treatment of

chronic pain. Survey design incorporated responsive design and skip logic to improve relevance of survey questions to individual participants, and to reduce survey fatigue. A subgroup analysis of respondents reporting chronic pain, defined as pain lasting greater than 3 months, was conducted. Descriptive statistics for demographics, chronic pain etiologies and treatments, risk (DAST-10) and benefit (modified Brief Pain Index) assessments are reported.

Results: A total of 4,993 patients were enrolled in the survey pilot study. Of respondents, 2,306 (36%) reported suffering from chronic pain. The most common etiologies were muscle or joint pain (25.3%) or arthritis pain (21.9%). Of chronic pain sufferers, 812 (52.3%) reported experiencing pain at least 5 times a week and 74.2% experienced it within the last week. 1,593 (69.1%) used over-the-counter medications to treat their pain in the past 12 months and 1,258 (54.6%) used prescription drugs. 1,369 used opioids and 75.7% reported high benefit from these medications. 3% of those with chronic pain had a score of 9-10 on the DAST-10 indicating a high degree of problems related to drug/medication use. Of respondents without chronic pain, only 0.6% had a DAST score in this range.

Conclusions: Overall, this pilot study describes patients with chronic pain and the types of medications they commonly use. Those in this subgroup tend to use over-the-counter medications, prescription medications, and opioids for treatments. Of those who use opioids, reported benefits tend to be high. However, those with chronic pain also have higher rates of opioid use disorder (as indicated by their DAST-10 scores) than those without. Future studies will focus on the identification of subpopulations of patients with chronic pain who experience high risk and low benefit from opioids, as well as those with low risk and high benefit. This can ultimately be used by providers when prescribing medications to determine how and when to use opioids to best help patients.

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80. Nail polish exposures treated at emergency departments

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Background: Nail polish or varnish is a cosmetic product used to decorate nails. Nail polish is available in a variety of colors and may contain of a variety of formulations or chemicals, some of which, such as toluene, formaldehyde, and butyl and ethyl acetate, may be toxic. Adverse exposures may occur through ingestion, inhalation, or skin or eye contact. Clinical affects associated with adverse nail polish exposure include oral or throat irritation, respiratory problems, chest pain, headache, abdominal pain, vomiting, ocular irritation or pain, dizziness, and drowsiness. The objective of this study was to characterize nail polish exposures managed at United States (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. In order to identify nail polish exposures reported during 2000-2019, records with the letter combinations "nail" and either "pol" or "varn" in the record narrative were reviewed, and those that appeared to be nail polish exposures were included in the study. The distribution of estimated nail polish exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.

Results: A total of 269 nail polish exposures were identified, resulting in a national estimate of 7,951 exposures. By four-year period, there were 1,592 (20.0%) exposures during 2000-2003, 1,578 (19.8%) during 2004-2007, 1,887 (23.7%) during 2008-2011, 2,016 (25.4%) during 2012-2015, and 879 (11.1%) during 2016-2019. The patient age distribution was 7,185 (90.4%) 0-5 years, 113 (1.4%) 6-12 years, 204 (2.6%) 13-19 years, and 449 (5.7%) 20 years or older; 3,200 (40.2%) of the patients were male and 4,751 (59.8%) female. The patient race was 3,906 (49.1%) white, 1,258 (15.8%) black/African American, 1,139 (14.3%) other, and 1,648 (20.7%) not stated. The exposure route was 5,039 (63.4%) ingestion, 1,605 (20.2%) ocular, 928 (11.7%) dermal, 473 (5.9%) inhalation, and 387 (4.9%) unknown. The reported location where the exposure occurred was 6,490 (81.6%) home, 84 (1.1%) other public property, and 1,378 (17.3%) not recorded. The most commonly reported clinical effects were 1,305 (16.4%) chemical burn, 575 (7.2%) foreign body, 362 (4.6%) vomiting, 324 (4.1%) dizziness, 227 (2.9%) conjunctivitis, 144 (1.8%) corneal abrasion, and 115 (1.5%) ocular irritation or pain. The patient disposition was 7,327 (92.1%) treated or examined and released, 61 (0.8%) treated and transferred to another hospital, 82 (1.0%) treated and admitted for hospitalization, 144 (1.8%) held for observation, and 338 (4.3%) left without being seen/against medical advice.

Conclusion: Nail polish exposures treated in EDs most often involved patients who were children age 0-5 years and female. The majority of exposures occurred by ingestion followed ocular and dermal contact. Most patients were treated or evaluated and released from the ED.

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81. Toxicological and pharmacologic sex differences in unintentional or undetermined opioid overdose death

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Background: Previous efforts to evaluate comparative risk for overdose mortality in women compared to men have focused on sex differences based on geography, presence or absence of prescribed opioid, and in populations on chronic opioid therapy. There has not been a detailed evaluation of sex differences in toxicological drivers of opioid-related drug overdose death, which could have meaningful implications to inform opioid prescribing practices and sex and gender-specific approaches to prevention and treatment.

Methods: A retrospective review of accidental or undetermined opioid-involved overdose deaths (aged 15 to 70) occurring in Rhode Island (RI) from 2016-2019 was performed using data from the RI Department of Health State Unintentional Drug Overdose Reporting System (SUDORS) database. For this study, data was extracted from SUDORS and de-identified. Decedent toxicology data was linked with prescription drug monitoring (PDMP) records to evaluate the association of prescribed

benzodiazepines and opioids (excluding buprenorphine) in opioid-involved drug overdose death. All drugs reported on toxicology testing in SUDORS were included.
Results: Of the 766 cases in the analytical sample, 568 cases were in men (74.2%) and 198 cases were in women (25.6%). The average age was 41.3 years for men and 42.9 years for women. Statistically significant sex-differences in drug co-exposures were found. Compared to men, women were more likely have co-exposure to benzodiazepine antipsychotic, and antidepressant drug classes and less likely to have alcohol co-exposure. No sex differences were found in cocaine and amphetamine exposure. Fentanyl(s) including fentanyl analogues and novel synthetic opioids were found on post-mortem toxicology testing in 70% female fatalities and 81% of male fatalities. Female decedents were more likely than male decedents to have a prescription in the PDMP for both benzodiazepines and opioids. Specifically, a benzodiazepine or opioid prescription (excluding buprenorphine) was found within 30 days prior to death in 40% of female decedents and women were approximately 75% more likely than men to have a benzodiazepine as a co-exposure found on post-mortem toxicology testing.
Conclusion: In this three-year population-based study, benzodiazepines, antipsychotics, and antidepressants co-exposures were more common among female decedents, while alcohol co-exposures were more common in male decedents. Higher rates of controlled substance prescription prior to death and prescription drug co-exposures suggest that female opioid-involved drug overdose decedents are often in contact with the health care system, presenting the opportunity to create patient-centric approaches to prevention, harm reduction, and substance use treatment.

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82. Helium inhalations reported to poison centers

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Background: Helium is a colorless, odorless, and tasteless inert gas. Inhaling helium from a balloon is well known to result in a temporary high-pitched, squeaky voice. Helium inhalation is typically harmless because the gas is physiologically inactive. However, breathing pure helium can cause death by asphyxiation. Helium inhalation from pressurized tanks can also be fatal by barotrauma. Therefore, helium intoxication can be intentional or unintentional. Some individuals will inhale helium to the point of passing out while others use helium to assist in suicide. Healthcare professionals should be aware of conditions associated with helium inhalation. The objective of this study was to describe helium inhalations reported to a statewide poison center network.
Methods: This is a retrospective epidemiologic study. Cases were helium exposures reported to a statewide poison center network during 2000-2020. The exposure route was inhalation. Case distribution was determined for various factors related to patient demographics, exposure circumstances, management, and outcome.
Results: A total of 249 helium inhalations were identified. By seven-year period, there were 75 (30.1%) cases during 2000-2006, 87 (34.9%) during 2007-2013, and 87 (34.9%) during 2014-2020. The patient age distribution was 16 (6.4%) 0-5 years, 127 (51.0%) 6-12 years, 65 (26.1%) 13-19 years, 37 (14.9%) 20+ years, and 4 (1.6%) unknown; 122 (49.0%) of the patients were male, 124 (49.8%) female, and 3 (1.2%) unknown. The inhalation reason was 137 (55.0%) intentional [94 (37.8%) intentional-misuse, 34 (13.7%) intentional-abuse, 7 (2.8%) intentional-suspected attempted suicide, 2 (0.8%) intentional-unknown], 111 (44.6%) unintentional, and 1 (0.4%) adverse reaction. The inhalation site was 193 (77.5%) patient's own residence, 18 (7.2%) another residence, 10 (4.0%) school, 10 (4.0%) public area, and 18 (7.2%) other/unknown. The management site was 140 (56.2%) on site, 65 (26.1%) already at or en route to a healthcare facility, 40 (16.1%) referred to a healthcare facility, and 4 (1.6%) at an unspecified other site. The medical outcome was 20 (8.0%) no effect, 40 (16.1%) minor effect, 48 (19.3%) moderate effect, 7 (2.8%) major effect, 9 (3.6%) not followed-judged nontoxic, 80 (32.1%) not followed-minimal clinical effects possible, 22 (8.8%) unable to follow-potentially toxic, and 22 (8.8%) unrelated effect; 1 (0.4%) death was reported. A clinical effect was reported in 197 (79.1%) of the cases, the most common being headache (n = 43, 17.3%), dizziness/vertigo (n = 43, 17.3%), syncope (n = 43, 17.3%), nausea (n = 23, 9.2%), vomiting (n = 19, 7.6%), chest pain (n = 14, 5.6%), and drowsiness/lethargy (n = 11, 4.4%). The most frequently reported treatments were fresh air (n = 130, 52.2%), oxygen (n = 24, 9.6%), and dilute/irrigate/wash (n = 22, 8.8%).
Conclusions: Most patients were older children and adolescents. The majority of the inhalations were intentional, particularly misuse. Only 7 of the 249 helium inhalations were intentional-suspected attempted suicide. Most patients were managed outside of a healthcare facility and did not experience serious outcomes.

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83. Impact of minimum age requirement increase on teen nicotine-containing product exposures reported to NPDS (January 2015-February 2021)

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Background: E-cigarette use has increased over the last few years, leading to public health concern. In response to the increased utilization, federal legislation was passed on 20 December 2019 to increase the minimum age requirement to purchase nicotine-containing products from 18 to 21 years of age. Research is needed to better understand this legislation's effect on teen e-cigarette use and all nicotine-containing product exposures.
Methods: Nicotine-containing product exposure data were obtained from National Poison Data System (NPDS) from January 2015 through February 2021. Monthly exposures were analyzed by product type (traditional cigarettes, e-cigarettes, and other/unknown nicotine products), age group (teen: 13-20, adult: ≥21), medical outcome (clinically significant: moderate or worse), and period (pre: 01 January 2015 to 31 July 2019, post: 01 April 2020 to 28 February 2021). A transition period of 20 December 2019 through 31 March 2020 was excluded from the analysis. Additionally, 01 August 2019 through 19 December 2019 was excluded from the analysis to control for a large spike observed in e-cigarette exposures. Rate ratios were calculated to compare all and clinically significant monthly exposures in the pre- and post-periods.
Results: Nicotine-containing product exposures involving teens accounted for 32% of all exposures included in this analysis (n = 4,396/13,940). Overall, 61% of all teen exposures were e-cigarettes, 29% were other/unknown nicotine products, and 10% were traditional cigarettes. Rates of all teen exposures to e-

cigarettes did not change between the pre- and post-periods, however, clinically significant e-cigarette exposures increased (pre: 4, post: 11; rate ratio [RR]: 2.52 (95% CI 2.00-3.18)). All teen exposures to other/unknown nicotine-containing products significantly decreased from an average of 21 exposures per month in the pre-period to 15 exposures per month in the post-period (RR: 0.71 (0.60-0.85)). All traditional cigarette exposures among teens also significantly decreased from 6 to 4 exposures per month (RR: 0.72 (0.52-0.99)). No statistically significant changes were observed among adults except for clinically significant e-cigarette exposures; this increased by a lesser degree compared to the increase among teens (pre: 4, post: 8; RR: 1.86 (1.44-2.39).
Conclusions: Nicotine-containing product exposures reported to NPDS may have been impacted by the nationwide increase in minimum age to purchase nicotine-containing products. Rates of all traditional cigarettes and other/unknown nicotine product exposures decreased significantly among teens. While the rates of all e-cigarette exposures were unchanged among teens, the rate of clinically significant exposures to e-cigarettes more than doubled, suggesting potentional unintended consequences from the legislation. Continued surveillance should be performed to assess the impact of this legislative change.

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84. Native venomous snake bites to dogs

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Background: There are four major types of poisonous snakes native to the United Snakes: rattlesnakes, copperheads, cottonmouths, and coral snakes. Bites by these snakes can result in serious adverse effects and even death. Humans are not the only species that may be bitten by these snakes. The objective of this study was to characterize native venomous snake bites to dogs reported to poison centers that primarily manage human exposures.
Methods: Cases were native venomous snake exposures (Generic codes 0137103, 0137104, 0137105, 0137106, 0137107) reported to a large, statewide poison center network during 2000-2020 where the exposure route was bite/sting, the patient species was animal, and the animal type was dog. The distribution of cases was determined for various factors.
Results: A total of 145 native venomous snake bites to dogs were identified. The type of snake was 52 (35.9%) copperhead, 47 (32.4%) rattlesnake, 13 (9.0%) coral snake, 11 (7.6%) cottonmouth, and 22 (15.2%) unknown crotalid. One (0.7%) of these bites occurred during December-February, 50 (34.5%) during March-May, 59 (40.7%) during June-August, and 35 (24.1%) during September-November. One hundred three (71.0%) of the bites occurred at the home of the dog's owner or caregiver, 2 (1.4%) at another residence, 6 (4.1%) at a public area, and 34 (23.4%) at an unknown location. Ninety-four (64.8%) of the dogs were managed at a healthcare facility or other location (probably a veterinarian facility), 44 (30.3%) outside of a healthcare facility, and 7 (4.8%) were managed at an unknown location. The most commonly reported clinical effects were puncture wound/sting (n = 67, 46.2%), edema (n = 45, 31.0%), and dermal irritation/pain (n = 22, 15.2%). Other clinical effects reported in association with ≤4 bites were erythema/flushed, drowsiness/lethargy, bleeding, ecchymosis, vomiting/agitation, confusion, dyspnea, excess secretions, hives/welts, and tremor. Thirty-seven (25.5%) of the stings were not considered to be potentially serious, 107 (73.8%) were considered to be potentially serious, and 1 (0.7%) was considered unrelated to the bite; no deaths were reported, but the poison center network generally does not follow animal exposures to determine final outcome.
Conclusion: These cases suggest that native venomous snake bites to dogs most often occur during the spring and summer and at the owner's own home. The majority of native venomous snake bites to dogs were managed at a healthcare facility, such as a veterinarian facility, and may result in serious outcomes.

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85. Scorpion stings to dogs: 2000 - 2020

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Background: Approximately 90 scorpion species occur in the United States. One species (*Centruroides sculpturatus*) is considered of medical importance to humans. The symptoms of scorpion envenomation may include localized pain, agitation, tachycardia, excessive salivation, and respiratory distress. Humans are not the only species that may be stung by scorpions. The objective of this study was to characterize scorpion stings to dogs reported to poison centers that primarily manage human exposures.
Methods: Cases were scorpion exposures (Generic code 0205240) reported to a large, statewide poison center network during 2000-2020 where the exposure route was bite/sting, the patient species was animal, and the animal type was dog. The distribution of cases was determined for various factors.
Results: A total of 166 scorpion stings to dogs were identified. Two (1.2%) of these stings occurred during December-February, 40 (24.1%) during March-May, 86 (51.8%) during June-August, and 38 (22.9%) during September-November. One hundred forty-three (86.1%) of the stings occurred at the home of the dog's owner or caregiver, 2 (1.2%) at another residence, and 21 (12.7%) at an unknown location. One hundred thirty-three (80.1%) of the dogs were managed outside of a healthcare facility, 32 (19.3%) were managed at a healthcare facility or other location (probably a veterinarian facility), and 1 (0.6%) was managed at an unknown location. The most commonly reported clinical effects were puncture wound/sting (n = 93, 56.0%) and dermal irritation/pain (n = 74, 44.6%). Other clinical effects reported in association with ≤6 stings were edema, cough/choke, ataxia, dyspnea, erythema/flushed, nausea, and vomiting. One hundred forty-three (86.1%) of the stings were not considered to be potentially serious and 23 (13.9%) were considered to be potentially serious; no deaths were reported, but the poison center network generally does not follow animal exposures to determine final outcome. The most frequently reported treatments were dilute/irrigate/wash (n = 53, 50.5%) and antihistamines (n = 12, 11.4%); other treatments reported in ≤4 stings were antibiotics, steroids, and benzodiazepines.
Conclusion: These cases suggest that scorpion stings to dogs most often occur during the summer and at the owner's own home. The majority of scorpion stings to dogs were managed on site and did not result in serious outcomes.

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86. Trends in cannabis exposures reported to a poison center in a legalized state during the coronavirus pandemic

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Background: Colorado has provided legal access to medical and adult-use cannabis since 2000 and 2012, respectively. The regional poison center (RPC) for Colorado has observed increases in exposure cases involving cannabis since 2009. The first case of novel coronavirus (COVID-19) in Colorado was confirmed on March 5, 2020. Many unprecedented events occurred during 2020 including closures of workplaces, schools, and public health orders to stay-at-home but marijuana businesses remained open. We hypothesized cannabis cases reported to RPC increased during this challenging period. The aim of this analysis was to characterize RPC calls during the novel coronavirus (COVID-19) pandemic and explore a temporal relationship between cannabis exposures in conjunction with COVID-19 public health data.
Methods: We queried the National Poison Data System (NPDS) using all available cannabinoid generic codes, excluding pharmaceutical marijuana and synthetic marijuana homologs, for closed human exposures in all ages from January 1, 2017 to December 31, 2020. The annual, month, and week volume of cannabis exposures in 2020 was compared to an epidemiologic curve of positive COVID-19 polymerase chain reaction (PCR) tests reported by Colorado's state or private labs. In order to determine if an increase was higher than expected given increasing trends, past 3-year annual, monthly, and weekly average and standard deviations (SD) were calculated as baseline. Case volume was compared to baseline and defined as higher if the frequency was greater than 2 SDs or defined as an anomaly if greater than 3 SD. Pearson's Chi-squared and a *p*-value <0.05 were used to determine significant differences in proportions of exposure characteristics.
Results: In 2020, 312 exposure cases reported to Colorado's RPC involved cannabis. This was higher compared to baseline (256.6 [SD =23.3]). The months with higher cases ($\geq$31) were March (n = 35) and July (n = 31) (Table 1). Weeks with higher cases ($\geq$ 10) coincided with the beginning of COVID-19 pandemic (first wave) and the third wave of COVID-19. Cannabis exposure cases varied by age, exposure reason, and type of product (all p= $<$0.0001). The highest proportion of cases were among children 0-5 years (42.9% [n = 134]. Cases among this age group during 2020 were higher compared to baseline (79.0 [SD =23.5]). Cases among adolescents 13-19 years (20.9% [n = 65]) were an anomaly compared to baseline (52.8 [SD =3.3]), with the most occurring during the third wave of COVID-19, in September (p = 0.0247). Additionally, during 2020, there were anomalies in the number of unintentional cases (n = 175 versus 112.3 [SD =14.9]) and cases with product type as cannabis edibles (n = 168 versus 112.3 [SD =10.3]) compared to baseline.
Conclusion: 2020 was a challenging year due to many disruptions to everyday lives from direct and indirect effects of the pandemic. While our analysis did not reveal an overwhelming surge that directly correlated with positive PCR tests, we did observe spikes during specific months of the pandemic which may be related to closure of childcare centers, increased time at home due to virtual learning and working from home, and self-quarantining. This unique year houses a wealth of data awaiting further exploration and analysis of all types will continue for years to come.

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87. Tipping your glass back to fight COVID-19? Don't do it!

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Background: 2020 was a unique year in the world. When the first case of the novel coronavirus was reported in the US on January 20, 2020, the passion to clean surfaces, homes, objects, clothing, and even ourselves skyrocketed. As proof, stores sold out of cleaning and disinfecting products quickly and demand could not keep up with supply. The spread of COVID-19 across the US and world in the spring of 2020 caused a great deal of panic, and many people were desperate to shield themselves from becoming infected with the virus. By late spring, it was being reported that some Americans had turned to ingesting bleach as a potential cure. The CDC issued a report in the summer of 2020 on unsafe coronavirus prevention practices that showed that 4% of the 502 respondents admitted to drinking or gargling with diluted bleach. Following the report, the study was criticized for quality and design flaws but the question remained provocative. We sought to analyze bleach exposures involving intentional misuse reported to our 4-state regional poison center (RPC).
Methods: We queried the National Poison Data System (NPDS) for all human bleach exposures reported to our RPC involving all reasons from 2016 to 2020. We then analyzed the intentional misuse cases separately during this same time period and compared it to the previous year to detect any trends. Descriptive statistical analyses were utilized.
Results: In 2020, total bleach exposures comprised 3.9% of total human exposures which was 40.5% more than in 2019 (2.76% of all exposures). We managed 33.7% more cases involving bleach exposures (n = 3387) as compared to 2019 (n = 2533). Cases of intentional misuse, however, increased a staggering 97% from 2019 (n = 68) to 2020 (n = 134) with the most number of cases occurring in April. When compared to percent of total bleach exposures for all reasons, intentional misuse of bleach represented 2.68% of total bleach exposures in 2019 and 3.88% in 2020 – an increase of 47.8%. The most commonly reported clinical effect following intentional misuse was dyspnea and throat irritation (11.9%), followed by dermal irritation (11.1%), cough/choke (9%), and nausea (8.2%). The age group with the most cases of intentional bleach exposures were 20 to 29 years. 52% were female and no patients were pregnant. Not surprisingly (given the shelter-in-place orders), 92.5% of bleach intentional misuse cases occurred at the caller's residence; 75% were managed on site. Despite the non-accidental nature of these cases, 84% resulted in minor or no effect with no occurrences of major outcomes or death. Route by ingestion when intentionally misused was up by 100% from 2019 (n = 19) to 2020 (n = 38)
Conclusion: Bleach exposures increased at our RPC in 2020 compared to the previous year, consistent with national trends. Our analysis suggests that the COVID-19 pandemic may have contributed to the increased incidence of people intentionally misusing bleach. Despite most cases resulting in minimal sequelae, this finding is still concerning. More education to dispel such claims should be utilized. Poison centers can represent an important tool in education.

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88. Trends of cough, cold, and antipyretic exposures reported to US poison centers during the coronavirus pandemic and influenza season

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Background: From confirmation of the first US Coronavirus case on January 21, 2020 to the US declaring COVID-19 a public health emergency on February 3, 2020, much of the country went into shut-down mode for most of the 2020 year. Schools implemented virtual classroom learning and much of the US workforce transitioned to working from the office to working from home. While cases of COVID-19 rose, the Centers for Disease Control (CDC) reported that cases of influenza decreased during the pandemic. We sought to determine if exposures involving cough, cold, and antipyretic agents reported to US poison centers (PCs) paralleled influenza trends in the face of rising COVID-19 cases.
Methods: We queried the National Poison Data System (NPDS) database nationally for human, unintentional cough, cold and antipyretic exposures from 2016 to March 31, 2021. Generic Codes included APAP alone, APAP or ibuprofen with diphenhydramine, ibuprofen, naproxen, and all NPDS cough and cold preparations. Cases involving suicide gestures, intentional misuse, and abuse were excluded. All ages were included and a separate analysis for children 0 to 5 years was conducted. Influenza rates used were those reported by the CDC. Descriptive statistics characterizing trends were performed.
Results: As cumulative cases of COVID-19 climbed in 2020, cases of influenza dropped as compared to previous flu seasons. As of May 22, 2021 there have been 32,912,150 million confirmed cases of COVID-19 in the US from January 2020. There were 39-56 million influenza cases reported in the 2019-2020 flu season. The official data for the 2020-2021 flu season is not yet released but according to the Morbidity and Mortality Weekly Report from September 18, 2020, following widespread adoption of community mitigation measures, positive influenza tests decreased to 2.3% (previously >20%). PCs observed a 19.8% reduction in calls involving unintentional exposures in all ages to cough, cold, and antipyretic products and a 23.3% reduction from similar exposures in children 0 to 5 years of age. Despite the reduction in case volumes to these products, we observed an increase in the severity of outcomes from 2019 to 2020. Major outcomes went from 0.2608% of total cases in 2019 to 0.3676% in 2020, representing a 41% increase and deaths increased by 50.1% (0.0284% in 2019 to 0.0428% in 2020).
Conclusion: The 2020 year represented a unique public health crisis. Ongoing analyses of numerous health parameters will continue to reveal the story. PCs in particular saw shifts in their normal call volumes and types of exposures. As overall cases of influenza decreased, COVID-19 cases sustained surges throughout the year. Cases involving unintentional exposure to cough, cold and antipyretic agents were down from the previous year including children under 5 years of age. This could represent different symptomatology from the coronavirus necessitating different pharmaceutical use or could represent the impact of people being home more and thus extra supervision to prevent accidental childhood exposure. Additional research is needed to include trends from 2021.

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89. 10 year NPDS characterization of pyrethrin and pyrethroid exposures reported to US poison centers

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Background: Pyrethrins are plant-derived insecticides extracted from the plant and dried flowers of the Chrysanthemum species of plants. Pyrethroids are synthetic versions of pyrethrins. These compounds are commonly used in residential as well as commercial settings for protection against indoor and outdoor insects such as cockroaches, spiders, flies, ants, bed bugs, and in animals, fleas and ticks. Because of their relatively low mammalian toxicity, these compounds are extensively used in the US year-round. Poison centers have seen a decline in exposure cases involving pyrethrin and pyrethroids in the last decade. We sought to characterize pyrethrin/pyrethroid (collectively called Pyrethrins) exposures reported to US poison centers over the last decade and propose explanations for the reduced case volume.
Methods: We queried the National Poison Data System (NPDS) for human exposures of all ages involving any of the following generic codes: 0144000 (piperonyl butoxide with pyrethrin), 0201045, 0144001 (pyrethrins), and 0201046 (pyrethroids) between the years of 2011 to 2020. Output evaluated were case volume, route, reason, clinical effects, gender, medical outcomes, generic codes, and management site. Descriptive statistics were utilized to analyze the data.
Results: From 2011-2020, a total of 281,841 human exposures involving pyrethrins were identified and the trend over this 10-year period was declining (R^2=0.6896). 2012 saw the highest number of pyrethrin exposures (n = 30,884, 1.35% of total cases) and 2020 had the lowest number (n = 24,117, 1.13% of total cases). This represents a 22% reduction in gross case volume and 16% reduction when relative to total case volume. Pyrethrin exposures comprised 1.13-1.35% of total case activity reported to US PCs with an average of 1.29%. Age range with highest number of cases was 0-5 years (25%) followed by 20-29 years (12%). 51.5% were female (0.4% were pregnant).The most common symptoms reported (percent of total symptoms) were cough/choke (9.85%), other/miscellaneous (9.69%), ocular irritation (9.57%), dermal irritation (6.88%), and vomiting (6.54%). The top 5 reasons represented 94% of total reasons for exposure: unintentional general (51%, unintentional misuse (26%), environmental (11%), adverse reaction (3%) and intentional misuse (2%). The top 3 routes were dermal (32%), ingestion (28%), inhalation (28%) with ocular representing 11% of cases. 78.6% were managed onsite. There were 37 (0.01%) deaths reported during this 10-year period. Minor, minimally suspected, or no effects occurred in 81% of cases.
Conclusions: While pyrethrin exposures result in a small percentage of case volume for poison centers, they are nonetheless regular encounters. Actual cases involving these compounds have trended down over the last decade, but percent of total volume has remained relatively flat. EPA label changes aimed at safer use of these compounds that occurred in 2009 and 2013 *may have prevented an uptick in case activity* despite their high popularity, as well as the increasing interest by consumers to look for natural or "green" alternatives for insect control. When minor exposures do occur, expected medical outcomes will also likely be minor or without effect. Additional stratification such as single substance exposure analysis and magnitude of exposure should be looked at for additional correlations and conclusions.

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90. Anticonvulsant fatalities reported to the American Association of Poison Control Centers 2000 - 2019

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Background: Anticonvulsants are among the most prescribed medications, and potentially toxic exposures are commonly reported to American Association of Poison Control Centers (AAPCC) participating sites. The purpose of this study was to describe the epidemiology of fatal isolated anticonvulsant ingestions, including patient demographics, specific medications, and the circumstances surrounding the ingestions.
Methods: This is a retrospective analysis of fatal single-substance anticonvulsant ingestions reported to the AAPCC National Poison Data System (NPDS) from 2000 to 2019. Polydrug ingestions and parenteral exposures were excluded, as were fatalities attributed to medications better classified differently, e.g., benzodiazepines and barbiturates. Patient characteristics, circumstances of the ingestion, specific medication, and chronicity of use were described.
Results: We identified 126 single-substance fatal anticonvulsant ingestions. The five most implicated anticonvulsants were carbamazepine, gabapentin, lamotrigine, phenytoin, and valproic acid. The majority (73%) of fatal ingestions were intentional, including 86 (68%) suicides. Phenytoin was implicated in eight (88.9%) of the adverse reactions and seven (70%) of the therapeutic errors. Valproic acid caused one (11.1%) adverse reaction and was associated with one (10%) therapeutic error. Three (75%) of the remaining unintentional fatalities were caused by carbamazepine. From 2000 – 2004, valproic acid accounted for the most fatalities. From 2005 – 2014, phenytoin and valproic acid were equally implicated in fatal ingestions. Gabapentin caused the most fatalities between 2015 – 2019.
The median age for victims of fatal ingestions was 52 years old. The median patient age was 33 years for carbamazepine, 35 years for lamotrigine, 40 yers for gabapentin, 44 years for valproic acid, and 66 years for phenytoin. Five (62.5%) of the fatalities in patients over 80 years old were from phenytoin.
The plurality (42.1%) of fatal ingestions occurred in acute-on-chronic use. An additional 40 (31.7%) were acute. Chronic use accounted for 15 (11.9%) of fatal ingestions, including five fatalities attributed to therapeutic error. The chronicity of medication use was unknown in 18 (14.3%) of fatal ingestions.
Fatality rates could not be calculated for the entire time covered by the study. However, from 2012 – 2019, we were able to measure rates for the five most implicated anticonvulsants. Narrative summaries were available in 14 cases. Four of the patients presented to the emergency department with minimal symptoms. The other 10 had varying degrees of central nervous system (CNS) depression. Seizures were observed in six cases. Hyperammonemia was reported in seven of the nine summarized fatal valproic acid ingestions.
Conclusions: The mortality rate from isolated anticonvulsant ingestions is low and typically occurs following intentional acute-on-chronic overdoses. Fatal adverse reactions and therapeutic errors are most associated with phenytoin use and disproportionately affect elderly patients. Seizures and CNS depression are common, and most fatal valproic acid ingestions are associated with hyperammonemia.

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91. Access to opioid treatment facilities in opioid overdose patients by race and ethnicity on behalf of the ACMT Toxicology Investigators Consortium (ToxIC)

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Background: Opioid Treatment Programs (OTPs) have been shown to be effective in the treatment of opioid use disorder (OUD). Studies on OUD have found that the majority of patients with OUD and patients who participate in OTPs are non-Hispanic and Caucasian. The reasons for low participation in OTPs by racial/ethnic minorities is likely multi-factorial and not completely understood. Limitations such as distance to OTPs may preclude enrollment in an OTP. Therefore, the primary purpose of this study is to evaluate distance to nearest OTP by race/ethnicity.
Objectives: This study characterizes the racial and ethnic composition of a sample of opioid overdose patients and measures the distance to the closest OTP from the presenting hospital. Additionally, the five most common opioid toxicities associated with hospital presentation and medical outcomes were characterized by race/ethnicity.
Methods: This study was a retrospective analysis of data extracted from the American College of Medical Toxicology (ACMT) Toxicology Investigators Consortium (ToxIC) registry. Patients presenting between 2014 and 2020 with intentional opioid toxicity requiring naloxone administration were included. Hospitals outside of the US, patients 2-6 years old, and patients without age range or race/ethnicity data available were excluded. Recorded patient race/ethnicity were collected along with presenting hospital site, opioid type, and medical outcome. Using the hospital address as a proxy for patients' neighborhood demographics, median distance to the nearest certified OTP as listed by the SAMHSA directory was reported across various races/ethnicities. Two sample Kolmogorov-Smirnov testing was used to compare median distances for non-Hispanic Caucasians to other races/ethnicities. Chi-squared testing was performed to compare types of opioid toxicities and severe medical outcomes between non-Hispanic Caucasians and racial/ethnic minorities.
Results: A total of 459 patients were included in the data analysis. Of these, 316 (69.9%) were male, 142 (30.9%) were female and one whose gender was not recorded. The majority of patients (85.4%) were in the 19-65 age range. Hispanics had a significantly higher median distance to OTPs when compared to non-Hispanics ($p < 0.0001$) yet no statistically significant difference was found between Caucasians and non-Caucasians. The most common opioid overdose was heroin (194, 42.3%). Patients with "other" race compared to Caucasians had higher rates of fentanyl overdose ($p = 0.002$). Hispanics compared to non-Hispanics presented with higher rates of fentanyl overdose ($p < 0.0001$). Compared to Caucasians, Asians and non-Caucasians had higher rates of acute kidney injury (AKI) ($p = 0.0242$), Black/Africans had higher rates of respiratory depression ($p = 0.043$), American Indian/Alaska Natives had more referrals for addiction medicine ($p = 0.0289$), and Black/Africans had higher rates of death ($p = 0.0402$). When compared to non-Hispanics, Hispanics had higher rates of acute lung injury (ALI) ($p = 0.006$) and had higher referral rates to addiction medicine ($p < 0.0001$).
Conclusions: A robust analysis of data evaluating access to opioid treatment programs across various races and ethnicities

reveals the need for ongoing investigation. This analysis further elucidates the interplay between race, ethnicity, and distance to OTPs, types of opioid overdoses and medical outcomes. Further analysis may identify limitations to OTP access in vulnerable patient populations and inform public health efforts.

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92. Tiletamine-zolazepam abuse and withdrawal in a veterinary health worker

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Background: The rising prevalence of opioid use disorder in the US has received a great deal of recent attention. Healthcare professionals are at increased risk of substance use disorders compared to the general population but are often reluctant to seek help. There is a paucity of literature regarding substance use disorders in veterinary healthcare workers, but the misuse of veterinary medications in this population is increasingly recognized. We report a case of tiletamine-zolazepam (Telazol®) abuse by a veterinary healthcare worker to self treat opioid use disorder.
Case report: A 35-year-old male veterinary technician presented to an urban Emergency Department complaining of tremor, jerking movements, and yellowing of his peripheral vision. He eventually admitted to using the veterinary anesthetic Telazol®, an equal mixture by weight of tiletamine, an arylaminocycloalkanone dissociative anesthetic related to ketamine, and zolazepam, a pyrazolodiazepinone sedative-hypnotic structurally related to benzodiazepines. He had a history of opioid use disorder on methadone maintenance and had read about the potential of ketamine as a treatment for substance use disorders. He began using Telazol 2-3 times daily starting 2 weeks before presentation. He developed rest and intention tremors 1 week into his use that increased in intensity with brief periods of abstinence. He began using unspecified doses of parenteral diazepam and midazolam to treat the tremors, but they worsened as his Telazol supply was depleted. On the day of presentation, the tremors became too severe to conceal at work and he could not obtain intravenous access for his last Telazol dose.
In the ED he was tachycardic to 115 and hypertensive to 151/104. He experienced visual hallucinations prior to ED arrival, but none in the hospital. Exam revealed a clear sensorium, resting tremors affecting all extremities that worsened with intention and frequent myoclonus involving the upper extremities. Visual acuity was 20/20 in each eye without corrective lenses and color identification was intact. CBC and CMP were normal, but UDS detected benzodiazepines and confirmatory testing revealed diazepam metabolites.
He was admitted to intensive care and received 160 mg of diazepam and 9 mg of lorazepam over 72 hours for tremor, hypertension, and tachycardia. No seizure activity was noted. After 24 hours, he reported resolution of the yellow discoloration in his peripheral vision. Tremors improved during admission but did not resolve and he was discharged on a diazepam taper.
Discussion: Substance abuse among physicians and nurses garners a great deal of attention but other healthcare professionals are also at increased risk. Veterinary healthcare workers have access to agents not available to other professionals and may attempt to treat their own medical conditions using pharmaceuticals not approved for human consumption. The prevalence of veterinary medication abuse is underreported and toxicity or withdrawal from these agents may not be considered by treating clinicians.
Conclusion: Clinicians should consider the possibility of veterinary pharmaceutical use in this population. Healthcare workers may not be forthcoming about efforts to manage their own conditions with agents available in their places of employment and a thorough history is needed to uncover these cases.

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93. Retrospective review of toxicity associated with kratom use and associated antidotal therapies

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Background: Kratom (*Mitragyna speciosa)* is a rapidly emerging drug of abuse in the United States. Reports of product adulteration with xenobiotics, metabolites including 7-hydroxymitragynine, and varying published responses to antidotal therapy limit the ability to effectively treat and triage patients presenting to a regional poison center (RPC) after exposure. The aim of this study was to categorize symptoms, outcomes, and treatment modalities for this emerging drug of abuse.
Methods: We conducted a retrospective review of all cases reported to an RPC serving approximately 12 million individuals. Trained data abstractors blinded to study aims recorded demographic and historical ingestion information, SPI-coded outcome data, clinical information, biochemical information, and descriptions of pre- and in-hospital antidotal therapy. We included cases with symptoms reported after recent use, overdose, or evidence of toxicity. Those cases lost to follow-up, informational calls, reported allergic reactions, incompletely documented, and situations of kratom withdrawal were excluded from analysis.
Results: A total of 115 cases were evaluated, 47 of which were reported in the final year (2019). 27 cases were excluded for reasons described previously, with a remaining 88 cases eligible for study. The average age of included patients was 31.9 years, with a range of 2-62. 72.7% identified as male. 98% of the included cases received care at a health-care facility (HCF), and 45 cases involved a co-ingested substance (most commonly an opioid, benzodiazepine, ethanol, and cannabinoids at 12.5%, 11.3%, 11.3%, and 7.9% of total cases respectively). Clinical outcomes are described in Table 1. The most common antidotal therapy administered was naloxone (14.7% of patients), with a single case of a kratom-only ingestion responding to continuous naloxone infusion, and another patient with ethanol and kratom use whose intubation was prevented with in-hospital naloxone. Two patients with presumed drug-induced liver injury independent of other xenobiotic use received n-acetylcysteine and recovered to baseline. A single fatality related to overdose had a serum mitragynine level of 190 mg/mL at autopsy. Presence of co-ingestion ($n = 45$) was not predictive of severity of clinical outcome when compared with kratom-only ingestions (13.9% and 15.5% respectively had severe or death outcome, $p = NS$). Presenting VS, laboratory studies, pupillary size, reason for use, and dose ingested were not useful in predicting severity of outcome.
Discussion and conclusion: We observed that the majority of acute, symptomatic kratom exposures originated from a HCF. The diversity and number of cases complicated by a co-ingested substance with CNS toxicity limits interpretation of antidote therapy effectiveness. In addition to CNS and respiratory depression, seizures were a common life-threatening toxicity. In the context of similar published reports, several cases of kratom-only exposures with a brisk response to naloxone without associated harm suggest a role for prospective evaluation of this therapy.

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94. The impact of forensic revenue on a clinical toxicology service

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Background: Clinical revenue is regulated by multiple regulations that severely restrict the ability of the provider to charge and collect revenue from both the patient and third-party payors. In contrast, forensic income usually has no such limitations. Medical toxicology is uniquely positioned to provide these non-clinical consultations and access this revenue source when compared to other clinical medical services. We describe the financial impact of the integration of forensic revenue within a clinical medical toxicology service over the past 19 years with a focus on the latter stages of the practice.
Methods: This is a single-network retrospective review of billing and revenue data covering the lifespan of a clinical toxicology service. Clinical revenue is defined as direct patient care reimbursement obtained either from the patient (co-pay or self-pay billing) or third-party health care insurers. Forensic revenue (as included in the analysis) is defined as non-clinical revenue encompassing independent medical examinations (IME), health hazard evaluations for pharmaceutical companies, industry contracted work, and record reviews not directly related to litigation or requested by attorneys (medicolegal). These record reviews were primarily requested by insurance adjusters through third party companies; record reviews obtained from directly from attorneys (medicolegal) and research income (grants) were not included in this analysis. Furthermore, all direct clinical revenue was excluded from this analysis. The practice duration was from July 2001 through September 2020. Industry contracts were billed separately. The practice primarily involved one full-time-equivalent (FTE) medical toxicologist. Minimum hourly billing was $300/hr, with a three-hour minimum.
Results: Prior to fiscal year (FY) 2005, forensic revenue was negligible (under $13,000 per year which accounted for less than approximately 5% of yearly revenue). In FY 2006, forensic revenue was $74,366.02 and it first exceeded $100,000 ($129,122.36) in FY 2008. It should be noted that in FY 2013, forensic payment per current procedural terminology (CPT) code was $933.66 per billing occurrence as compared to inpatient revenue of $98.60 per CPT code and office collection of $356.76 per CPT code billed.
Conclusion: Forensic toxicology activity provides a significant and sustainable revenue stream for any clinical practice that can be an important component to incorporate into a business plan. Forensic medical toxicology consultations are the ultimate "fee for service" model devoid of outside restrictions from governmental or third-party regulations. Given the revenue collected is independent of changes to individual insurance and external payor influences, and fluctuations associated with clinical consultation volume, forensic consultations may provide stability to a clinical toxicology practice.

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95. Death of a private medical toxicology practice: a postmortem analysis

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Background: In the year 2020, the COVID-19 pandemic applied pressure that led to the largest and oldest dedicated medical toxicology practice in our state and forced closure and restructuring of several other individual and group practices as well. We hypothesized that progressive changes in reimbursement patterns, increasing clinician comfort with EMR-based order sets, and decreasing direct patient care consultation volumes contributed to these changes.
Methods: We conducted a retrospective review of financial data of a medical toxicology practice encompassing four hospitals and one outpatient clinic site from July 2001 through September 2020. All patients were evaluated regardless of ability to pay and there was no change in practice policy during this period. Each of the patient encounters were billed by current procedural terminology (CPT) codes through the biller designated by the medical group. The practice contracted three billing companies during this period, with only a single biller for the final ten years. Some patients had more than one CPT code charge per encounter. For years where data was available, charges, revenue, EMR order set usage, reimbursement rates (RR), and consultation volume were reviewed. Addiction medicine, forensic, and industry consultations were excluded from this analysis.
Results: CPT billing encounter data, charges, revenue, and RR over time are outlined. By 2020, there was an almost 80% decline in number of encounters with an over 60% decline in charges and revenue from peak years. This was accentuated by a decrease of 60% in charges from April to September 2020 (peak time of COVID-19 as compared to the previous six months with a corresponding decline of work RVU of 58% (687 pre-COVID/six months to 396 during COVID/six months). We did not observe any significant change in RR during the final 15 years of practice and observed a stable final billing denial rate of $<2.5\%$. Electronic medical record (EMR) based medical toxicology inpatient order set usage started in year seven and has been utilized over 10,000 times since its inception (approximately 1,100 times/year; Fig 1) – this has been associated with a sharp reduction of inpatient consultations after FY 9. During the study period, CPT code 99291 (critical care, coded for approximately 25% of inpatient consultations) billing declined from a peak of $1033 in 2011 to only $655 in 2018. Beginning in around 2016, CPT codes 99358 and 93042 (for prolonged non-face-to-face care and rhythm strip interpretation, respectively) were eliminated from use and further decreased clinical income.
Discussion and conclusion: Despite a low final denial rate suggestive of efficient billing and stable RR, the practice's number of encounters, charges, and revenue declined substantially over the final ten-year period. These changes were related to declining reimbursement, success of a toxicology-led EMR order set program, and finally with the near elimination of an outpatient practice in the setting of the COVID-19 pandemic. Toxicologists should consider these implications when designing a business model for a pure bedside clinical practice.

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96. Fatalities from cocaine: an investigation from the National Poison Data System (2015-2019)

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Background: Drug overdoses involving cocaine are a continuing global public health issue. The United Nations World Drug Report estimates 20 million cocaine users worldwide. In 2018, more than one in five fatal drug overdoses in the United States involved cocaine. The purpose of the study was to investigate

the magnitude and trends in national poison-related fatalities from cocaine exposure as reported by the National Poison Data System (NPDS).

Methods: The research team conducted a retrospective study using cocaine-related fatality cases reported in five annual NPDS reports (2015-2019). The data represent calls to 55 regional members of the American Association of Poison Control Centers. Extracted demographic and cocaine-related circumstances of fatality cases included reporting year, age, gender, chronicity, and intent of poison exposure.

Results: A total of 655 deaths were reported due to cocaine, with 66.9% (N = 438) attributed to males. Annually NPDS reported fatalities varied over the 5-year study period, with 54 deaths (8.2%) reported in 2015, 85 (13.0%) in 2016, 187 (28.5%) in 2017, 214 (32.7%) in 2018, and 115 (17.6%) in 2019. When stratified by age groups, 6 (< 1%) cases involved persons younger than 18 years, 192 (29.3%) involved persons aged 18-29, 198 (30.2%) involved persons aged 30-39, 107 (16.3%) involved persons aged 40-49, 88 (13.4%) involved persons aged 50-59, 44 (6.7%) involved persons aged 60-69, 5 (< 1%) involved persons aged 70-79, and 1 (< 1%) involved a person 80 and over. Cocaine was rated as undoubtedly responsible for 65.2% of the fatality cases (N = 427) and probably responsible for 28.2% of the cases (N = 185). Multiple substances were reported in 89.0% of cocaine-related deaths (N = 583), although cocaine has been identified as substance and cause rank 1 or rank 2 in nearly 80 % of all reported cases. Regarding intent, 72.8% (N = 477) of the exposures was reportedly due to intentional abuse, and another 11.3% (N = 74) was due to suicidal intentions. Overall, suicidal intent accounted for 19.0% of the fatality cases in females and 7.5% in males.

Conclusions: Between 2015 -2019, NPDS reported cocaine-related fatality was highest in 2018; and among persons aged 30-39 and persons aged 18-29. In addition, cocaine-related fatality cases was higher in males than in females. However, suicidal intent among female fatality cases was higher than in males. Based on study results, increasing efforts for public health education in age groups between 18-40 years is recommended, along with a focus on evidence-based and gender-specific strategies. Recommendations for future research include expanded analysis of COVID-19 impacts on cocaine use and overdose. Poison control centers play an important role in public health prevention efforts. Exploring expanded efforts for interprofessional collaboration on prevention should be considered, especially due to recent COVID-19 events. Persons with substance use disorders were overrepresented with hospitalizations and death during the COVID-19 pandemic (NIDA, 2020), and should be a focus on future research and poison prevention efforts.

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97. Acrylfentanyl pediatric fatality

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Background: Determining the specific cause of a cardiopulmonary arrest in a teenager can be difficult. In suspected overdose cases, the diagnosis can be particularly elusive because many new synthetic substances of use are not detected on routine urine hospital tests, especially in the United Stated where synthetic fentanyl analogs are increasingly resulting in deaths. We present a case in which gas chromatography-mass spectrometry (GC-MS) was used to detect the designer opioid, acrylfentanyl, in the urine obtained from the emergency department in a patient who suffered a pre-hospital cardiac arrest.

Case report: A 15 year old male was found unresponsive in his room by his mother in the morning when she entered his room to awaken him. Cardiopulmonary resuscitation (CPR) was initiated by the mother. The child was found with pulseless electrical activity by first responders who continued CPR and obtained return of spontaneous circulation after two rounds of epinephrine. The child was intubated and obtunded following the arrest. Vaping material and marijuana were found in the patient's room. He was reported to have a history of experimenting with drugs. This led to concern for drug exposure causing his cardiopulmonary arrest.

Acetaminophen and salicylate levels were undetectable. A urine drug of abuse panel was positive for THC and benzodiazepines (given at the hospital post-intubation) and was negative for amphetamines, barbiturates, cocaine, ethanol, opiates, phencyclidine, oxycodone, and methadone. The patient suffered from profound acidosis, cardiogenic shock, acute kidney injury, shock liver and anoxic brain injury with cerebral edema. He did not recover and was pronounced dead 5 days after he was found in arrest.

Because of the unclear circumstances surrounding this event, a urine sample was analyzed by the university laboratory's liquid chromatography with tandem mass spectrometry (LC-MS-MS). After review, the urine was suspected to contain acrylfentanyl and was sent for designer opioid testing (NMS lab 1480U). This was positive for acrylfentanyl and 4-ANPP, a fentanyl metabolite. Police were involved in the case and an individual was arrested and charged with distribution of drugs to the patient.

Discussion: Throughout the last decade, fentanyl analogs have been used with increased frequency in the United States as adulterants or substitutes for other drugs of abuse such as heroin, oxycodone and cocaine. Few cases of fatal acrylfentanyl overdose are reported in the literature in the United States and none in the pediatric age group. This is likely because it goes undetected. Routine urine drug screens do not detect the novel fentanyl analogs and so these drugs will only be detected if they are checked for specifically and early in the case (e.g., original urine or blood saved at the time of presentation).

Conclusion: There are many substances that are not detectable on routine urine drug screens. Specific identification of these drugs is not always clinically necessary in the acute setting. In potential forensic cases, clinicians should obtain extra urine and/or blood immediately on presentation to help determine the exact cause of death, assist with public service warning, and aid law enforcement with the prosecution of distributers.

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98. A pediatric ingestion of a zinc phosphide laced cookie: to PPE or not to PPE?

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Background: Zinc phosphide (ZP) ingestion can result in consequential toxicity even when ingested in small quantities. ZP reacts with hydrochloric acid in the stomach to form phosphine gas; inhalation of phosphine gas can produce significant pulmonary and cardiovascular effects. One previous case report describes a fatality after ingesting only 6 grams.We describe a single case of a 4-year-old boy who ingested ZP but had a good outcome.

The Poison Control Center (PCC) was contacted for provider personal protective equipment (PPE) recommendations.
Case report: A four-year-old boy presented to the emergency department complaining of abdominal pain after eating a cookie that had been intentionally laced with ZP for use as a pesticide in the home. The parent had purchased the ZP outside of the country and brought it to the United States. The maximum ZP the child could have ingested was 4 grams per parent- they laced the cookies with 5g of 80% ZP). His initial vital signs were: Blood Pressure, 99/60 mmHg; Pulse, 114 per minute; Respiratory Rate, 26 per minute; Temperature, 100.1°F (rectal);Oxygen saturation, 99% on room air. A venous blood gas was obtained and showed a pH 7.392 and PCO2 41.8 mmHg. His other laboratory tests including a complete blood count, basic metabolic panel and serum transaminases were all within normal limits. The regional PCC recommended wearing Power Air-Purifying Respirator in a negative pressure room based on the small ingestion history from the parent; self-contained breathing apparatus (SCBA) were not recommended. The patient was admitted to the hospital and observed overnight. The next day, he had a complete recovery and was discharged home.
Discussion: Phosphine is a toxic gas and providers caring for severely poisoned patients have developed toxicity after exposure to exhaled phosphine. There is significant practice variation in personal protective equipment use and providers may inadvertently expose themselves during triage prior to being aware of the patient's ingestion. The Pipeline and Hazardous Materials Safety SCBA in contaminated areas. Additionally, hospitals and commercial ambulance services may not have SCBA available for their health care staff. In a massive overdose, it may be reasonable to treat the patient's outside of a closed environment and in an ambulance bay. While in the emergency department, the regional Poison Control Center was contacted due to concern for provider safety. This was a relatively small exposure (maximum 4g of ZP) in a well-appearing child and there was low risk to providers of a significant phosphine gas exposure. Hazardous materials response was contacted and went to the patient's apartment to remove any additional ZP. This case highlights the difficulty of determining appropriate personal protective equipment when managing ZP ingestions, especially with small exposures.
Conclusion: Zinc Phosphide Ingestion may cause significant toxicity and could affect providers treating patients with ZP ingestion due to risk of phosphine gas exposure. If the risk of phosphine gas exposure is significant, a SCBA should be worn. For a ZP ingestion, PCCs should be contacted regarding appropriate PPE.

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99. Lithium hemodialysis clearance

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Background: Although kinetic studies from the 1990's demonstrate that hemodialysis efficiently removes lithium (Li), limited data are available using modern hemodialysis techniques and direct measurement of lithium in spent dialysate. We assessed two patients with lithium toxicity who received emergent hemodialysis to document the current efficiency of lithium clearance by hemodialysis.
Case series: Patient 1: A 27-year-old woman presented with 2 weeks of slurred speech, difficulty walking, tremors, nausea, vomiting, and diarrhea during an acute SARS-CoV-2 infection. Her initial serum [Li] was 4.7mmol/L. She had an acute kidney injury (AKI)(creatinine 2.48mg/dL). She received emergent hemodialysis for 3 hours at a blood flow rate of 225-300mL/minute and a dialysate flow rate of 700mL/min using a Rexeed 18s filter. Samples of serum, urine, and dialysate effluent were collected hourly. Over 3 hours, a total of 43.26 and 2.4mmol of Li were collected in her dialysate and urine, respectively. Calculated clearances ranged from 84-150mL/min.
Patient 2: A 68-year-old man with bipolar disorder presented to the emergency department complaining of chest pain and suicidal ideations. His physical examination was unremarkable and ECG showed no active ischemia. His [Li] was 7.3mEq/L. The patient underwent two sessions of HD; 2 hours and then 3.58 hours using a Revaclear filter at a blood flow rate of 190-300mL/min, and a dialysate flow of 800mL/min. Blood was obtained from the circuit immediately before and after the filter twice per session. Hemodialysis clearance was calculated from the blood flow, hematocrit (48.8%), and extraction ratio. The mean extraction ratio of both sessions was 93%. Calculated clearances ranged from 90-143mL/min.
Discussion: The efficiency of hemodialysis in lithium poisoning is best indicated by its clearance in comparison to the patient's intrinsic clearance. Renal clearance of lithium is reportedly 25% of creatinine clearance. In the first patient with AKI, hemodialysis exceeded endogenous clearance over 17-fold and removed more than 45mmol in 3 hours. In an older report of a patient with a similar AKI, hemodialysis exceeded endogenous clearance by as much as 37-fold (mean 16-fold). One recent report recovered only 36mmol of Li after 4 hours of hemodialysis. Calculated hemodialysis clearances provide an approximation of lithium removal. In the second case a high extraction ratio yielded a maximal clearance of 143mL/min. Most older publications report extraction ratios of 70-80% and use lower blood flow rates than current techniques. At least one contemporary publication reports an extraction of 97% and a clearance of 178mL/min.
Conclusion: Using two different methods, one of which includes direct comparison of hemodialysis to endogenous clearance, and one directly measuring dialysate [Li], we demonstrated that lithium removal using modern dialysis machines is highly efficient. Assessments that use calculated clearances yield reasonable approximations of removal but tend to overestimate because they do not account for endogenous clearance. We encourage evaluation of hemodialysis efficiency through rigorous collection of dialysate effluent, urine, and blood pre- and post-filter concentrations to accurately determine clearance and extraction ratios.

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100. Skeletal muscle relaxants

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Background: Skeletal muscle relaxants (SMR) encompass a broad group of pharmaceuticals that are used for treatment of spasticity or musculoskeletal pain. These medications can cause dizziness, weakness, sedation, and antimuscarinic effects with therapeutic use as well as in overdose. The American Geriatric Society recommends that SMR be avoided in elderly patients primarily due to the increase in fall risk they pose. The purpose of

this study was to characterize trends in SMR cases over time and characterize outcome severity based on patient age groups.
Methods: This was a retrospective observational study of the National Poison Data System (NPDS) cases involving cases to cyclobenzaprine, carisoprodol, methocarbamol, baclofen, chlorzoxazone, metaxalone, orphenadrine, and any combination products that include one or more of these medications from 2009-2019. Patients younger than 20 years old were excluded from the study.
Results: A total of 211,396 SMR cases were reported to the NPDS with 19,641 cases in 2009 and 18,749 cases in 2019. There was a steady decrease in cases from 2009-2019 of approximately 122 cases per year (R2 = 0.39). The most common SMR included cyclobenzaprine (37.2%), carisoprodol (21.9%), baclofen (15.9%), and tizanidine (13.7%). Most cases occurred in females (64.8%). Mean age was 42 ± 14.4 years. The distribution of cases varied by age group; patients 20-59 years accounted for 88.3% of cases, while those ≥60 years accounted for the remaining 11.7%. The majority of cases involved intentional exposures, with self-harm attempts accounting for 60.0% of all cases.
A total of 55,495 cases involved single substances. The most common single substance SMR were cyclobenzaprine (32.0%) followed by carisoprodol (25.4%) and baclofen (18.8%). A majority of single substance cases resulted in either no or minor effect (54.7%). Major effect was seen in 7.4%, while death occurred in <1% of cases. Baclofen single substance cases were responsible for the greatest number of severe outcomes (moderate effect, major effect, and death) (25.8%, $p < 0.01$).
Outcomes for single substance cases differed between patients ≥60 years versus those 20-59 years ($p < 0.001$). No effect was similar between the two groups (18.0% vs 14.8% respectively; OR 1.27, 95%CI: 0.59-1.35). In comparing older versus younger cases, minor effect was less common (34.1% vs 40.0%; OR 0.78, 95%CI 0.74-0.82), moderate effect was similar (39.0% vs 37.8%; OR 1.05, 95%CI 0.99-1.11) and major effect was more common (8.4% vs 7.3%; OR 1.16, 95%CI: 1.05-1.27). Finally, death was also more common in older cases (0.5% vs 0.1%; OR 5.57, 95%CI: 3.54-8.74).
Conclusion: A decrease in annual SMR cases was observed over the course of the study period. Older individuals were more likely to have more serious outcomes. Cases involving baclofen were associated with the most severe outcomes of each of the individual SMR agents.

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101. Lidocaine overdose: tumescent liposuction jeopardy

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Background: Tumescent liposuction currently applies subcutaneous injection of diluted (0.05-0.10%) lidocaine as a wetting solution to ease the suction process. Herein, we report near-fatal lidocaine toxicity from this procedure.
Case report: A previously healthy 32-year-old male underwent tumescent liposuction at a private clinic. His bodyweight was 49 kilograms. He was injected with a wetting solution: 2% lidocaine 60 mL and adrenaline 0.2 mg in 500 mL of Ringer's lactate solution (final 0.21% lidocaine) subcutaneously at the back of both thighs. The patient was doing well after 20 mL of fat removal. Thirty minutes later, a second dose of a 500-mL wetting solution was injected into the abdomen and he developed a generalized tonic-clonic seizure for 15 minutes soon after. He was intubated and received intravenous diazepam 20 mg by the emergency medical services. The blood pressure was 60/40 mmHg. The heart rate became bradycardia (40 bpm) unresponsive to 0.6 mg intravenous atropine and finally progressed to cardiac arrest with no electrical pulse. Cardiac resuscitation was performed for 31 minutes before the return of spontaneous circulation (ROSC) at the emergency department. Slightly after that, 10 mL/kg of 20% intravenous lipid emulsion was given for 30 minutes. He was transferred to the intensive care unit without inotropes. Venous blood gas showed marked metabolic acidosis with pH 6.86, bicarbonate 10 mEq/L, and lactate 18 mmol/L. Computerized tomography of the brain and pulmonary angiogram showed no evidence of fat embolism. An electrocardiogram after ROSC showed sinus tachycardia with prolonged QT (555 milliseconds). The patient later received targeted temperature management. The total length of stay was 15 days. Unfortunately, he developed severe hypoxic-ischemic encephalopathy and became bedbound thereafter. The reported lidocaine level (2 hours after cardiac arrest) in this patient is 16.5 mcg/mL.
Discussion: This patient received a total dose of 2,400 mg of lidocaine (49 mg/kg) in 30 minutes which is far higher than the maximal recommended dose by the US FDA (7 mg/kg). However, the current practice of tumescent liposuction allows the use of wetting solutions that contain a maximum dose of 55 mg/kg of lidocaine. Despite the alarmingly high dose, the drug is often diluted and suctioned out during the procedure and finally does not result in lidocaine toxicity. We believe our patient experienced toxicity because of 1) inadvertently intravenous injection, 2) high dose of lidocaine, and 3) high concentration of the wetting solution and 4) metabolic acidosis from seizure that also worsened the toxicity.
Conclusion: This case demonstrated flaws in mega-dose lidocaine administration which resulted in severe lidocaine toxicity. If a high dose of lidocaine is to be injected, close monitoring is ultimately advised and an antidote (intravenous lipid emulsion) should be readily available.

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102. Iatrogenic intracervical administration of digoxin during pregnancy

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Background: Intrafetal digoxin is used as a feticidal agent to achieve asystole during abortion procedures. It is injected transabdominally into the amniotic fluid or transvaginally targeting the fetus. We report a first case of an iatrogenic administration of 2 mg digoxin injected into the maternal cervix during an elective abortion procedure. This resulted in supratherapeutic digoxin levels and maternal toxicity.
Case report: A 20-year-old previously healthy, 8 week pregnant patient presented to an emergency department (ED) from an abortion clinic. During the abortion procedure 2mg of digoxin was inadvertently administered directly into the cervix instead of lidocaine. She developed a "woozy" feeling, weakness and was bradycardic at 53 bpm. In the ED, a digoxin level of 12.8 ng/ml was measured 1.5 hrs post-injection. The patient was admitted for observation. Her subsequent digoxin levels were 4.3 ng/ml at 7 hours, 2.6 ng/ml at 12.5 hours, and 1.8 ng/ml at 18 hours post-injection. The patient continued with bradycardia with a range of 48-78 bpm throughout the observation period. She was initially normotensive, followed by subsequent episodes of hypotension with blood pressure readings of 90s/40s. Her electrocardiogram

(EKG) showed premature ventricular complex (PVC) and multiple premature atrial complexes (PACs) but her PR, QRS and QTc intervals remained normal. Potassium levels ranged from 3.3 to 4.8 mmol/L. Her serum creatinine was 0.56-0.62 mg/dL during her hospital stay. The patient described tingling/numbness of the tongue and experienced nausea with vomiting. Treatment included ondansetron, ranitidine and intravenous fluids. Digoxin immune FAB was neither indicated nor administered to this patient. Her PACs and PVC resolved prior to discharge at 20 hours post the inadvertent intracervical digoxin administration. She was noted to still be pregnant prior to discharge.

Discussion: Oral or IV digoxin is indicated for atrial fibrillation, heart failure or left ventricular dysfunction. Digoxin has off-label use as a feticidal agent. Minimal pharmacokinetic parameters are known regarding the less preferred IM route known to cause tissue irritation. In therapeutic doses, we expect a distinct distribution phase (two-compartment model) lasting 6-8 hours. This case report of an iatrogenic injection of digoxin into the cervix, resulted in elevated pre-distribution digoxin levels followed by a gradual decrease over 20 hours. The patient's symptoms of bradycardia, PACs/PVCs, nausea, vomiting and weakness were consistent with acute digoxin toxicity. Her symptoms improved and resolved as her digoxin levels trended down.

Conclusion: We report a first case of maternal toxicity from an iatrogenic intracervical injection of 2 mg digoxin. Digoxin levels decreased and the patient returned to baseline with symptom resolution within 20 hours.

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103. Comparison of two novel intravenous N-acetylcysteine regimens

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Background: N-acetylcysteine (NAC) is the treatment of choice for acetaminophen overdose and is used off-label for treatment of acute liver failure and alcoholic cirrhosis. The FDA approved regimen for NAC consists of three separately compounded infusions given at three separate infusion rates. This regimen is prone to dosing and administration errors given the multiple steps required for proper and timely administration. Novel regimens exist simplifying the three infusion process to two separate infusions. Herein we describe two such novel regimens comparing their safety, efficacy, and rate of medication errors. Regimen one consists of a loading dose of 150 mg/kg administered intravenously over one hour followed by a second infusion of 150 mg/kg administered as 50 mg/kg over four hours then 100 mg/kg over 16 hours. Regimen two consists of a loading dose of 200 mg/kg administered intravenously over five hours followed by a second infusion of 100 mg/kg infused over 16 hours.

Methods: Data was collected via retrospective chart review of patients receiving NAC from May 5, 2018 - May 6, 2021. Patients were divided into group one (5/5/18 - 5/5/21) and group two (5/6/20 - 5/6/21) Patients were excluded if they were under 16 years of age or had NAC ordered outside of an approved order set. Data was collected including demographic information as well as the incidence of medication errors and type of medication errors. Safety and efficacy data was collected and compared. In addition, a variable was created to indicate whether a patient had an adverse reaction or a medical error. Statistical analyses included Chi-Square tests and Wilcoxon Rank-Sum tests.

Results: 121 charts were reviewed to date and a total of 99 were included in the results. 71 patients received regimen one and 28 patients received regimen two. Group one had a total of 28 (39%) medication errors whereas group two had a total of 6 (21%) medication errors ($p = 0.143$). Errors included delays in changing the infusion rate (>1 hour), delays in treatment (>1 hour), and errors in order entry. The most common source of medication errors was delay in treatment which occurred in 17% of patients in group one and in 14% of patients in group 2. Group one had 17 (24%) adverse reactions compared to group two which had four (14%) ($p = 0.432$). Adverse reactions included dizziness, hypotension, itching, nausea, rash, and tachycardia. Group one had an average length of stay of 7.6 days and regimen two had an average length of stay of 4.9 days ($p = 0.102$). For the variable addressing whether a patient had a medication error or an adverse event, group one had 37 (52%) events and group two had 8 (29%) events ($p = 0.058$).

Conclusions: Regimen two was associated with a non-statistically significant reduction in medication errors, adverse events, and length of stay. There was also a reduction in the chance that a patient would have any medication error or adverse reaction that approached significance with a $p = 0.058$. Overall regimen two is trending toward significance but a larger sample size is needed to ascertain this.

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104. Administration of intravenous 50% dextrose as a trigger tool for iatrogenic hypoglycemia

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Background: Trigger tools have been used in many other areas of patient safety to identify patients at risk of decompensation, or who have had an iatrogenic event occur. The use of 50% dextrose as a trigger tool for iatrogenic hypoglycemia has not yet been studied. We sought to determine the feasibility of using administration of 50% dextrose as a trigger tool to detect iatrogenic hypoglycemia in patients receiving intravenous insulin as part of a hyperkalemia protocol.

Methods: The setting is a 202 bed Veterans Affairs medical center. All 50% dextrose removals from an automated dispensing cabinet for a 90-day period were reviewed to determine which doses were part of a hyperkalemia protocol, and which were given for hypoglycemia. The use for hypoglycemia was determined by documentation of D50 being ordered for hypoglycemia or nursing note that it was given under a hypoglycemia protocol orderset. The subset of patients who received a second dose of D50 after receiving an initial dose with a hyperkalemia orderset were reviewed for evidence of hypoglycemia. The identified charts were then compared to medication safety reports for the same issue (hypoglycemia after IV insulin administration under a hyperkalemia protocol). Additional data collected included age, gender, baseline GFR, pre-treatment potassium and glucose levels, and number of doses of 50% dextrose administered. All patient specific identifiers were removed from the abstracted data.

Results: 202 separate charts were reviewed corresponding to documented removal of D50 from the ADC attached to a patient name. Of these, 6 were determined to have been an error. Of the remaining 196 incidents, 114 were identified as being given as part of the initial treatment for hyperkalemia. Of the

remaining 82 events, 40 were given for hypoglycemia not related to a hyperkalemia protocol. 42 doses were identified as being given in response to hypoglycemia after receiving IV insulin for treatment of hyperkalemia. This was determined by documented hypoglycemia (blood glucose ≤60 mg/dL) within 12 hours of receiving IV insulin under the hyperkalemia protocol. When medication safety reports during the same time period were reviewed, 24 reports were matched to incidents from this review. The 42 separate administrations of D50 occurred in 37 patients, with two patients getting 2 doses and 1 patient receiving 4 doses. The patients were 98% male (n = 36), with a mean age of 63 (range, 43-92). Mean glucose prior to insulin administration was 177 mg/dL (range, 83-597) and mean pre-treatment potassium was 6.2 (range, 5.6-8.0). Mean glucose prior to treatment for hypoglycemia was 49 mg/dL (range, <20-66). Mean eGFR was 23 (range, 2-87). All of the patients requiring additional bolus doses of D50 had an eGFR <30. Only 2 of the patients treated for hypoglycemia after IV insulin administration had an eGFR >60. Most patients received a dose of 10 units of regular insulin IV.

Conclusion: Chart review of patients receiving intravenous 50% dextrose revealed more hypoglycemic events than determined by safety reports. The use of 50% as a trigger tool may more accurately measure iatrogenic hypoglycemic events in this patient group.

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105. Intravenous iron: ironically benign

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Background: Iron is available for therapeutic use in both oral and intravenous formulations. Iron toxicity is characterized by nausea, vomiting, diarrhea, anion gap metabolic acidosis, altered mental status, hepatic failure, and hemodynamic compromise. Severe poisoning warrants chelation therapy with deferoxamine. Some experts use a 4-6 hour iron concentration greater than 500 mcg/dL (89.5 micromol/L) as one criterion for chelation. We present a patient who experienced an intravenous iron overdose with an initial iron concentration of 1753.5 mcg/dL (313.9 micromol/L) who did well with supportive care and was not given deferoxamine.

Case report: A 65-year-old man with a past medical history of end stage kidney disease presented to an outpatient clinic for routine hemodialysis. During dialysis, he was unintentionally given 1000 mg of iron sucrose intravenously, instead of an intended dose of 100 mg. Within 1-2 hours, the patient experienced nausea, vomiting, diarrhea, abdominal pain, headache, and paresthesias in hands and feet. Post-dialysis vitals signs included: blood pressure, 102/73 mmHg;; HR, 118 beats/minute; respiratory rate, 20 breaths/minute; Temp, 97.8 F. Physical examination was notable for diffuse abdominal discomfort without signs of peritonitis. Post dialysis laboratory assays demonstrated an iron concentration of 1753.5 mcg/dL (313.9 micromol/L) , white blood cells of 13,000/mm3, bicarbonate of 16.9 mEq/L, and an anion gap of 17 mEq/L. The patient was admitted for monitoring, intravenous fluids, and supportive care. Vital signs normalized and the patient's abdominal pain resolved. A repeat iron concentration approximately 12 hours later was 606 mcg/dL (108.5 micromol/L). At no point did the patient develop an acidemia.

Discussion: Iron sucrose is a compound with a large molecular weight and was designed to release iron slowly over several days following intravenous administration. Iron concentrations can be extremely elevated in cases of iron sucrose overdose since the laboratory not only measures free iron, but will also measure nontoxic iron that is complexed to carbohydrate (iron sucrose). Our case illustrates one of the pitfalls of relying on the iron concentration alone when determining the need for chelation therapy.

Conclusion: Iron overdose can be devastating and an iron concentration of greater than 500 mcg/dL (89.5 micromol/L) is proposed as one criterion to initiate chelation therapy with deferoxamine. This recommendation is based on oral iron overdoses and cannot be applied to intravenous iron overdose. Our patient did well despite a high initial serum iron concentration because a majority of the measured iron was nontoxic. The decision to initiate deferoxamine after an acute intravenous iron overdose should be based on clinical findings such as anion gap metabolic acidosis and hemodynamic instability as opposed to an iron concentration alone.

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106. Impact of a pharmacist-led toxicology consult service on appropriate use of intravenous N-acetylcysteine for acetaminophen toxicity

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Background: Intravenous (IV) N-acetylcysteine (NAC) is approved by the Food and Drug Administration for the treatment of acetaminophen toxicity as a 21-hour, three-bag regimen. This regimen consists of a loading dose followed by two maintenance doses, each with different infusion rates. Additional doses are recommended if signs of continued toxicity are present near the end of the third dose. Due to the logistical complexities of administration, many opportunities for medication errors exist. In 2018, a pharmacist-led toxicology consult service, in collaboration with the regional poison control center (PCC), expanded from the emergency department to include inpatient units. This expansion aimed to create a consistent point of contact for the regional PCC to the institution, as well as improve transitions and continuity of care of poisoned patients, such as those with acetaminophen toxicity, throughout their hospital admission. The purpose of this study was to evaluate the impact of a pharmacist-led toxicology consult service on the proportion of patients who experienced any error associated with IV NAC treatment for acetaminophen toxicity.

Methods: This was a retrospective, pre-post cohort study of patients who received IV NAC for suspected or confirmed acetaminophen toxicity between September 1, 2015 and May 26, 2020 at a large community hospital system. Patients were categorized into two groups in relation to the consult service expansion: pre-group (September 1, 2015 to December 31, 2017) and post-group (January 1, 2018 to May 26, 2020).

The primary endpoint was the proportion of patients who experienced one or more errors associated with IV NAC treatment for acetaminophen toxicity. An error was defined as inappropriate dose, administration rate, initiation, continuation, or discontinuation of IV NAC. Appropriateness of dose and administration rate

was determined based on the three-bag regimen described in the package insert for acetylcysteine. Criteria for appropriate initiation, continuation, and discontinuation were adapted from *Goldfrank's Toxicologic Emergencies, 11th Edition*. Secondary endpoints included proportion of patients experiencing each type of error, interruptions in therapy greater than one hour, hospital length of stay (LOS), and in-hospital mortality.
Results: There were 84 patients that met inclusion criteria: 30 patients in the pre-group and 54 patients in the post-group. Baseline characteristics were similar between groups. The proportion of patients with one or more errors associated with IV NAC treatment was significantly lower in the post-group (37% vs 66.7%, $p = 0.009$). The post-group also had a lower incidence of inappropriate discontinuation of IV NAC treatment (14.8% vs 50%, $p < 0.001$). Interruptions in therapy greater than one hour (50% vs 26.7%, $p = 0.038$) and hospital LOS (2.7 vs 2 days, $p = 0.029$) were significantly higher in the post-group. Other secondary outcomes were similar between groups (Table 2).
Conclusion: Implementation of an inpatient pharmacist-led toxicology consult service was associated with a lower proportion of patients who experienced one or more errors related to IV NAC treatment for acetaminophen toxicity.

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107. Nitrous oxide inhalation abuse and misuse reported to poison centers

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Background: Nitrous oxide (N_2O), commonly known as laughing gas or nitrous, is a colorless, non-flammable gas used as an anesthetic, an aerosol propellant (whipping cream, cooking oil), and in rockets and automobile racing. It can be purchased in grocery and convenience stores and over the Internet in small cartridges called "whippets." Individuals may inhale nitrous oxide as a recreational intoxicant due to its euphoric, dissociative, and sometimes hallucinogenic effects. Nitrous oxide abuse has been reported to be increasing. The objective of this study was to characterize nitrous oxide inhalation abuse and misuse cases reported to United States poison centers.
Methods: Cases were intentional abuse and misuse inhalation exposures to nitrous oxide reported to the National Poison Data System during 2000-2020. The distribution of total cases was determined for factors related to patient demographics, exposure circumstances, patient management and outcome.
Results: A total of 1,369 cases were identified (92.9% intentional abuse, 7.1% intentional misuse). By seven-year period, 26.2% of cases were reported during 2000-2006, 27.9% during 2007-2013, and 45.9% during 2014-2020. Age distribution was 1.8% 6-12 years, 24.8% 13-19 years, 33.7% 20-29 years, 18.6% 30-39 years, 15.4% 40+ years, and 5.8% unknown age; 66.1% of patients were male, 32.9% female, and 0.9% unknown gender. Exposure site was 79.0% at home, 3.3% other residence, 2.7% public area, 1.5% workplace, 1.0% school, 0.3% healthcare facility, 2.0% other, and 10.2% unknown. No other substances were reported in 1,052 (76.8%) of total cases. Of these, the management site was 61.8% at or en route to a healthcare facility, 18.8% referred to a healthcare facility by the poison center, 15.3% on site, and 4.1% at an unspecified or unknown site. The medical outcome was 6.3% no effect, 17.8% minor effect, 26.2% moderate effect, 5.8% major effect, 0.5% not followed-judged nontoxic, 15.5% not followed-minimal clinical effects possible, 22.2% unable to follow-potentially toxic, and 5.1% unrelated effect. Six (0.6%) deaths were reported. A clinical effect was reported in 80.1% of cases without other substances. The most common clinical effects were confusion (n = 117, 11.1%), numbness (n = 101, 9.6%), tachycardia (n = 98, 9.3%), ataxia (n = 84, 8.0%), and drowsiness/lethargy (n = 83, 7.9%). The most common treatments were fresh air (n = 189, 18.0%), intravenous fluids (n = 105, 10.0%), supplemental oxygen (n = 101, 9.6%), and benzodiazepines (n = 53, 5.0%). Vitamin B12 therapy was not documented in any case.
Conclusions: Nitrous oxide inhalation abuse and misuse cases increased over the 21 year time period. Most patients were age 13-29 years and male, were managed at a healthcare facility, experienced moderate-major effects, and included poison center contact when either at or en route to the hospital. Despite being known to cause vitamin B12 deficiency related neuropathy this was not recommended and may be an area of education.

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108. Long term survival after acute colchicine overdose treated with hemodialysis and plasmapharesis

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Background: Colchicine is commonly prescribed for the treatment of inflammatory conditions but has a narrow therapeutic window and dangerous toxicity profile. The major mechanism of action of colchicine is to inhibit microtubule assembly, resulting in a predictable cascade of events which in overdose can lead to severe morbidity and mortality. Here, we describe a case of severe colchicine overdose complicated by multi-organ failure, sepsis, and prolonged ICU course, treated with continuous renal replacement therapy (CRRT) and plasma exchange with survival to hospital discharge.
Case report: A 37-year-old male with a history of chronic idiopathic pericarditis and subtotal pericardial resection five years prior presented from home to a tertiary care Emergency Department with a chief complaint of nausea, vomiting, and diarrhea, after ingesting 60 tablets of 0.6mg (36mg) colchicine 17 hours prior to arrival. An initial colchicine level resulted at 5.1ng/mL and peaked at 12 ng/mL 40 hours post-ingestion. He developed significant sequelae of colchicine poisoning including coagulopathy, respiratory failure, neuropathy, renal failure, pancytopenia, and heart failure. He was treated with CRRT beginning on his first day of hospitalization and with plasma exchange on hospital days two through four. The patient had a prolonged hospitalization complicated by atrial fibrillation with rapid ventricular response, pneumonia, and sepsis. After clinical improvement, he was discharged to inpatient rehabilitation on hospital day 24. On outpatient follow up four months after discharge the patient was found to have persistent peripheral neuropathy, but no other significant persistent morbidity related to colchicine overdose.

Discussion: Arrest of mitosis caused by colchicine results in the classically described phases of acute colchicine overdose. Ingestions of colchicine approaching 0.5 mg/kg often result in significant toxicity, while doses of greater than 0.8 mg/kg have been reported with high mortality. In this case, the patient progressed through the traditionally reported triphasic syndrome of colchicine overdose, including early gastrointestinal manifestations and peripheral leukocytosis, DIC, rhabdomyolysis, sepsis, and arrhythmia, after an acute ingestion of 0.6mg/kg of colchicine. Despite colchicine's high volume of distribution and protein-binding, both high-dose CRRT and plasma exchange were initiated early given a predicted difficult clinical course.
Conclusion: This case demonstrates remarkable survival of an individual after a near-fatal colchicine overdose. Prudent administration of supportive care through vasopressors, continuous renal replacement therapy, transfusion of blood products and management of sepsis resulted in survival with minimal sequelae. This demonstrates that with efficient supportive care, survival after significant colchicine overdose is feasible.

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109. Pharm to table: designer benzodiazepine use on the rise

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Background: Designer benzodiazepines are psychoactive substances derived from the chemical structures of commonly prescribed benzodiazepines. Designer benzodiazepine manufacturing, marketing, and recreational use are not regulated. Cases of designer benzodiazepine associated toxicity have recently increased, especially in combination with opioids. Typical sedative-hypnotic effects are experienced with designer benzodiazepines, but additional adverse effects have been described. Clonazolam is a designer benzodiazepine and is known to have a potent and prolonged clinical effect. Data on clonazolam kinetics is limited.
Case report: A 32-year-old female with no known medical history was witnessed to have a syncopal event at an airport with subsequent drowsiness. EMS was called and she was taken to the emergency department. She was somnolent, confused, and possibly hallucinating. She was found to have HR 41, BP 139/90, RR 18, O2 100% on room air, T37.4 and a GCS of 13. Evaluation of her belongings revealed a small baggy with pressed blue pills, which she stated were fentanyl and "M-30s" (oxycodone 30mg); she stated possible ingestion of these pills. She was admitted to the hospital and had continued sedative-hypnotic clinical effects. She was ataxic, developed aspiration pneumonia requiring antibiotics, and had a prolonged hospital stay. She was discharged six days after initial presentation.
Materials: A complete blood count, metabolic panel, pregnancy test, ethanol, acetaminophen, aspirin, creatine phosphokinase, lactic acid and CT scan of the head returned without abnormalities. A routine immunoassay urine drug screen was positive for fentanyl, opiates and benzodiazepines. She did not receive opioids or benzodiazepines during or prior to her hospital stay. An EEG was done after a right-gaze preference was noted on exam and did not show seizure-like activity.
Serial blood samples, along with the pressed blue pills, were obtained and sent to a reference laboratory. Testing was performed by liquid chromatography mass spectrometry. Comprehensive toxicology screening assessed the presence of more than 900 drugs; positive results were confirmed quantitatively.
Discussion: We present a patient who endorsed opioid ingestion but instead manifested symptoms and clinical effects most consistent with a sedative hypnotic toxidrome. We believe her clinical effects were due to clonazolam toxicity as suggsested by her blood sample analysis. Atypical features such as bradycardia and prolonged duration of toxicity seen with this patient have been documented in the literature with clonazolam toxicity, however unilateral gaze preference has not been previously documented. Serial sample collection allowed for the assessment of half-life, calculated to be approximately 5.6 hours. This longer half-life could explain the prolonged effects.
Conclusions: Clonazolam is a designer benzodiazepine that has become more prevalent and may be used as an adulterant or marketed as an opioid. Additionally, drug products containing opioids and benzodiazepines are becoming more common in the recreational supply. Healthcare providers should be aware of clinical effects and duration of effects characteristic of designer benzodiazepines not typically seen with other sedative-hypnotics. More research is needed to determine accurate pharmacokinetic properties to help guide clinical management in the overdose setting.

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110. Intentional ingestion and death from flecainide and colchicine: case report

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Background: Flecainide, a cardiac sodium channel blocker and Colchicine, a potent inhibitor a microtubule formation and function can both produce life threatening toxicity in overdose. Both of these medications are uncommon among documented intentional ingestions in current literature. Currently it is not known how the multisystem effects of Colchicine can affect metabolism of other medications with narrow therapeutic windows after intentional ingestion. Hypothesis: Intentional co-ingestion of Colchicine with Flecainide can lead to worsening cardiotoxicity and death.
Methods: This is a single patient chart review. A 71-year-old male with medical history of atrial fibrillation, gout, hypertension and previous myocardial infarction ingested unknown amounts Colchicine and Flecainide in a suicide attempt 24 hours before presentation. Initial lab work found decreased renal function, acidosis, and widening QRS of 165 and QTc of 566. Aggressive bicarbonate treatment initiated with pH goal of 7.5 along with 2g magnesium. Over the next 24 hours, the patient required intubation and increasing vasopressor support for refractory hypotension and bradycardia.
Results: Despite aggressive resuscitation with bicarbonate, magnesium, vasopressor medications the patient continued to decompensate (never reaching pH goal of 7.5) requiring emergent pacemaker placement for severe bradycardia and hypotension. During placement, the patient lost pulses and was not able to be resuscitated. Post mortem drug levels showed concentrations of both Colchicine and Flecainide of 17ng/ML and 4900ng/mL respectively.

Conclusion: Co-ingestion of Colchicine with Flecainide increases cardiotoxicity by reducing renal clearance and metabolism leading to death.

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111. A fatal case of intentional yew needle ingestion

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Background: *Taxus brevifolia*, known as the Pacific Yew, is an evergreen shrub that is common to Oregon and the Pacific Northwest. The *Taxus spp.* are often seen in decorative hedging and topiary, though historically have been referred to as the "death tree" for its known toxicity. The yew contains cardiotoxic alkaloids including Taxine A and B, which are present in all parts of the plant except the red arils. Serious toxicity following accidental exposure is rare, however deliberate ingestions can result in life threatening effects including cardiac dysrhythmias, hemodynamic instability, seizures and death without intervention. We present a case of fatal poisoning after intentional ingestion of yew needles.
Method: The Oregon Poison Center (OPC) serves the state of Oregon, as well as the state of Alaska and the U.S. territory of Guam. Review of prehospital medical records was performed, as well as medical examiner reports.
Case report: A previously healthy 38 year old female was evaluated roadside by emergency medical services (EMS) after a call requesting a safety check was made by family with concern for suicide attempt. EMS arrived to find the patient pale and weak sitting in her car, but hemodynamically stable without other complaints. She stated she intentionally ingested three thermos cups of yew needles 30 minutes prior to evaluation. She stated she had researched the yew plant, confirmed there was no antidote and had premedicated with an antiemetic. A thermos and plastic bag of evergreen needles visually consistent with yew leaves was retrieved from the patient. Within minutes of EMS arrival, she became unresponsive and pulseless. Atropine, amiodarone and epinephrine were administered with multiple defibrillation attempts. Multiple cardiac rhythm strips were obtained from EMS records. Tracings were notable for a wide complex tachycardia that decompensated into a broad complex bradycardia, followed by an agonal rhythm and asystole. The patient expired 40 minutes later in the field. Serum samples obtained by the medical examiner were sent for analysis and taxine concentrations are pending at this time.
Discussion: The clinical course of this patient is consistent with fatal taxine poisoning secondary to yew needle ingestion. The ineffectiveness of traditional resuscitation strategies as well as presence of complex and difficult to interpret dysthymias are well documented in the literature. Field management of this patient proved difficult, highlighting the gravity of severe yew toxicity requiring advanced medical care in an inpatient setting.

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112. Development of liver injury despite early administration of acetylcysteine in acetaminophen overdose

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Background: Acetaminophen is a commonly used over-the-counter analgesic and antipyretic. Acetaminophen overdose is a growing health concern world-wide. When administered early, acetylcysteine is an effective antidote for acetaminophen overdose. However, recent studies have revealed that early administration of acetylcysteine may fail to prevent development of liver injury in some patients. We sought to compare the incidence of acute liver injury (ALI) in patients receiving acetylcysteine early with the 2-bag acetylcysteine regimen (200 mg/kg over four hours, 100 mg/kg over 16 hours) compared to the 3-bag regimen (150mg/kg over 1 hour, 50mg/kg over 4 hours, 100mg/kg over 16 hours).
Methods: Retrospective cohort study comparing 2-bag and 3-bag acetylcysteine regimens in Australia (2009 – 2020) and Canada (1980–2005). The 2-bag and 3-bag regimen cohort data were obtained from patient records at Monash Health, and compared to 3-bag regimen data from the Canadian Acetaminophen Overdose Study (CAOS) database. Inclusion criteria: patients with acute single ingestion of acetaminophen; normal ALT or AST on presentation; acetylcysteine administered $\leq$8 hours post-overdose; treatment decision based upon the adapted Rumack-Matthew nomogram. Primary outcome: development of ALI (defined as: peak ALT or AST $>$150 IU/L). Secondary outcome: development of hepatotoxicity (peak ALT or AST $\geq$1,000 IU/L).
Results: At Monash Health, 191 patients were treated with the 2-bag acetylcysteine regimen, and 180 patients with the 3-bag regimen. The CAOS cohort provided 515 patients treated with the 3-bag regimen. ALI developed in 1.6% (3/191) of the 2-bag Monash Health group, 2.2% (4/180) of the 3-bag Monash Health group (difference -1.6%, p 0.71), and 3% (15/515) of the 3-bag CAOS group (difference compared to 2 bag -1.4%, p 0.43). Hepatotoxicity developed in 0.5% (1 / 191) of patients treated with the 2-bag regimen, 1.7% (3/180) in the Monash Health 3-bag regimen and 1% (5/515) of the 3-bag CAOS group. There were no statistically significant differences between groups.
Conclusions: ALI and hepatotoxicity were observed in a small percentage of patients receiving early acetylcysteine using the 2-bag and 3-bag acetylcysteine regimens. Repeating blood tests at the end of acetylcysteine treatment will identify these patients and indicate those requiring extended therapy.

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113. Antifreeze ingestion causing methemoglobinemia: a case report

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Case report: 56-year-old man with past medical history of chronic back pain, scoliosis, obstructive sleep apnea, bipolar disorder, asthma and hypertension presented to an outside hospital (OSH) after being found drinking half of a bottle of Fleet Charge SCA Precharged 50/50 Prediluted Coolant/Antifreeze. Emergency medical services (EMS) reported that the patient became somnolent and cyanotic en route to the hospital. Upon arrival to the

emergency department (ED), vital signs (VS) included: heart rate (HR) 80 beats per minute, respiratory rate (RR) 23 breaths per minute (bpm), blood pressure (BP) 91/53 mmHg, SpO2 88% on 15L/min non-re-breather (NRB). The patient was lethargic and only arousable to painful stimuli and therefore intubated. The patient's blood was drawn and was chocolate brown in color. A methemoglobin concentration measured 43% (normal 0-3%). Initial laboratory testing included: white blood cell count (WBC) 6.4 thou/cmm (4.0-10.5), hemoglobin (HgB) 13.0 g/dL (12.5-17.0), hematocrit (Hct) 40.9% (37.0-48.0%), blood glucose level (BGL) 139 mg/dl, creatinine (Cr) 0.9 mg/dL (0.53-1.30), bicarbonate (HCO3) 16 mmol/L (23-31), sodium (Na+) 137 mmol/L (135-145), potassium (K+) 4.5 mmol/L (3.5- 5.2) and serum osmolality 466 mOsm/kg (279-295). An arterial blood gas (ABG) after intubation measured: pH 7.21 (7.31-7.41), carbon dioxide (CO2) 40.6 mmHg (41-51), oxygen (O2) 382.6 mmHg (83-108) and HCO3 of 15.9 mEq/L (23-29). A urine drug screen, serum acetaminophen, salicylate and ethanol concentrations were all negative. The patient was administered 2mg/kg of methylene blue intravenously (IV) with near immediate resolution of cyanosis. The patient was also administered intravenous (IV) fomepizole, IV sodium bicarbonate infusion, and then transferred to a tertiary care facility intensive care unit (ICU).

In the ICU, both fomepizole IV and sodium bicarbonate IV infusions were maintained, and both thiamine and pyridoxine were administered. The patient's initial ethylene glycol concentration measured 747.9 mg/dL (reference range = negative) and glycolic acid concentration 33.0 mg/dL (reference range = negative). Three hemodialysis treatments were performed with subsequent declination in ethylene glycol concentrations to 11.38 mg/dL on hospital day (HD) 3. The patient was extubated on HD 5 and was neurologically normal.

Discussion: Ingestion of Fleet Charge Coolant/Antifreeze causing combined ethylene glycol poisoning and methemoglobinemia has only once been previously reported (1). This is only the second case, but with an even higher methemoglobin measurement (43% and 32%, respectively). The product MSDS includes ethylene glycol, water, diethylene glycol and denatonium benzoate as its ingredients. However, Farkas et al. determined via direct discussion with the product manufacturer that this particular brand of antifreeze contained both sodium nitrate and nitrite. If enough product was consumed this would cause methemoglobinemia. No other source of methemoglobin in this patient's case has been identified.

Conclusion: This patient developed two potentially life-threatening poisonings from the same exposure yet requiring completely different, specific antidotal therapies. The patient had complete neurologic recovery.

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114. Alprazolam and lorazepam overdose mimicking brain death

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Background: A 70-year-old female was found unresponsive on the desk at the park. Upon EMS arrival, her vital signs were BT 35 °C orally, BP 90/60 mmHg, PR 70 bpm, rapid shallow breathing 16 times/min with oxygen saturation 85%. Glasgow Coma Scale was E1V1M4 with fixed 1-mm pupils in neutral positions. Corneal and ocular reflexes (doll's eye) were absent. The tone was flaccid. Cardiac, lung, abdominal, and skin examination were normal. Laboratory testing showed normal electrolytes and glucose. ECG revealed a sinus rhythm with a normal QRS interval and a QTc of 500 msec. She was intubated for airway protection. CT of the brain was normal. Two doses of 0.4-mg naloxone were then given concerning opioid overdose- despite negative opioids in the urine screening, without any response. Because her symptoms (comatose, abnormal breathing, and absence of brainstem reflexes) could suggest brainstem stroke, intravenous thrombolytics was delivered. Several hours later, her husband came to the hospital with empty zip bags of, altogether, 80 tablets of alprazolam and lorazepam. A toxicologist was consulted for a drug overdose. Unsurprisingly, urine benzodiazepines (BZP) screening was strongly positive. Her consciousness improved dramatically after a 0.25-mg of intravenous flumazenil. The final confirmatory tests of drugs showed: in blood- alprazolam 268 ng/ml (20-40 ng/mL), lorazepam 861 ng/ml (20-250 ng/mL), nordiazepam 481 ng/ml (200-600 mg/mL), oxazepam 14.9 ng/ml (500-2,000 ng/mL); in urine- alprazolam, lorazepam and metabolites, trazodone, clarithromycin, and omeprazole. Her previous medications included trazodone for insomnia; clarithromycin, omeprazole, and amoxicillin for *H.pylori* gastritis. She later informed the psychiatrist that she was depressed but unwilling to tell a detailed history of an overdose. After discharge, she lost all the follow-ups.

Discussion: One unique property of BZPs, GABA-A agonists, is they rarely cause respiratory depression or death even after substantial ingestion. Most severe cases from BZPs are secondary to a combination with other sedative-hypnotics. This patient was comatose with the absence of some vital brainstem reflexes which could be pointed to as "brain death". The addition of other drugs such as opioids, baclofen, or ethylene glycol may provide such symptoms, but the current data do not demonstrate an association between isolated BZP overdose and a loss of brainstem reflexes. Data are also limited for the dose of alprazolam and lorazepam to cause coma. A retrospective Australian study reported a patient comatose from a single alprazolam overdose (out of 38 cases) but failed to mention brainstem signs and drug level. The choice of BZP might as well influence the severity. The same study pointed out that alprazolam is a more potent CNS depressant than other BZPs. We believed that the extremely high level of alprazolam and lorazepam could explain the patient's brain-death-like symptoms. This was supported by a rapid improvement after flumazenil administration – a competitive BZP receptor antagonist. However, whether trazodone affected her symptoms remained unknown.

Conclusion: High-dose benzodiazepine toxicity may lead to a depressed consciousness and loss of brainstem functions, mimicking a structural brainstem lesion.

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115. Fluid volume and balance within the first 72 hours of hospitalization for calcium channel blocker or beta blocker overdose: a case series

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Background: Acute overdose of a calcium channel blocker (CCB) or beta blocker (BB) often requires multiple intravenous (IV) therapies to maintain hemodynamic stability (fluids, vasopressors,

glucagon, insulin, etc.). Management of these patients has historically included large volume IV fluid administration, although objective data regarding fluid balance is limited in the existing literature.
Objective: The primary objective of this study was to describe the fluid balance of patients with CCB or BB overdose at 12–, 24–, 36–, 48–, 60–, and 72–hours after presentation to a healthcare facility. We also reviewed subgroups of patients on 1 unit/mL and 10 unit/mL insulin infusions, identified specific sources of total fluids administered, and evaluated use of extracorporeal fluid removal via kidney replacement therapy or extracorporeal membrane oxygenation.
Methods: CCB and BB overdose cases presenting to 12 hospitals of a major university hospital system were identified through search of the regional poison center's medical records from 12/1/2015 to 3/08/2021. Inclusion criteria included age >11 years and receipt of vasopressor or inotrope therapy or documented bradycardia or hypotension. Patients with end–stage kidney disease, pre-existing heart failure with reduced ejection fraction, or who were missing >30% of data points were excluded.
Results: Twenty-five patients were identified with a median age of 39 and female (15/25) predominance. Independent CCB and BB overdose occurred in 10 and 9 patients, respectively; 6 patients ingested both. Amlodipine (9/25) was the most common agent. Four CCB cases included angiotensin converting enzyme inhibitor coingestion. Average mean arterial pressure and heart rate at presentation were 63 mmHg and 81 beats/min, respectively. Most patients (22/25) survived, and the median intensive care unit length of stay was 3 days (range 1-15 d). In the initial 24 hours, the median total volume administered was 7.8 L (range 2.5-21.6 L). Patients received high-dose insulin euglycemic therapy (HIET) from 5.5-132 hours. Those who switched from a bag concentration of 1 unit/mL to 10 unit/mL switched at 2-18 hours after starting HIET. The cumulative volume of fluid received in patients who received HIET was generally greater than in patients who did not, with dextrose and insulin each accounting for approximately 30% of all fluid administered. Extracorporeal fluid removal was initiated in 5 patients at 12 to 84 hours after presentation.
Conclusions: Patients with CCB and/or BB overdose receive >7 L of fluid within their first 24 hours of hospitalization. Concentrations of IV fluid sources (e.g., insulin 1 unit/mL vs. 10 units/mL) greatly impacted cumulative administered volumes. Clinicians should consider the amount of fluid in IV sources in this patient population, with judicious attention to fluid balance during care. With contemporary evidence indicating that over-resuscitation with IV fluids can be harmful in critical illness, this positive fluid balance may have detrimental effects to patient care, which further studies should elucidate.

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116. Severe bupropion overdose mimicking brain death necessitating prolonged extracorporeal membrane oxygenation

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Background: Bupropion is an atypical antidepressant that inhibits its reuptake of norepinephrine and dopamine, with negligible effects on serotonin. In overdose, bupropion causes seizures and, in severe cases, cardiotoxicity progressing to profound cardiogenic shock. We present a severe case of bupropion overdose who experienced a prolonged intensive care unit stay secondary to refractory seizures and cardiac arrest, and required veno-arterial extracorporeal membrane oxygenation (VA-ECMO).
Case report: An 18-year-old female with a history of anxiety and depression presented to an outside hospital reporting an intentional ingestion of an unknown amount of bupropion XL tablets to her parents. While in the emergency department, the patient experienced recurrent episodes of seizure-like activity accompanied by multiple episodes of cardiac arrest, necessitating transfer to a higher level of care. After arriving to the second healthcare facility, the patient underwent cannulation for VA-ECMO.
Her clinical condition remained largely unchanged throughout the first 10 days of hospitalization. Notable physical examination findings included bilateral fixed and dilated pupils, diminished bowel sounds and decorticate posturing. Diagnosis of anoxic brain injury versus on-going drug effect was considered. Bupropion and hydroxybupropion concentrations drawn hospital day (HD) 5 were 418 ng/mL (therapeutic: 10-100 ng/mL) and 2774 ng/mL (therapeutic: 850-1500 ng/mL) respectively.
On HD 8, she began exhibiting more purposeful movements in her extremities. Cardiovascular function improved and she was transitioned from VA-ECMO to veno-venous-ECMO (VV-ECMO) on HD 7, and eventually decannulated from VV-ECMO on HD 12. Over several days, she exhibited increased responsiveness with bupropion levels dropping below therapeutic on HD 17. On HD 23, she was extubated to high flow nasal canula. On this same day, the patient passed multiple intact tablets of bupropion in her stool. She also demonstrated signs of delirium and confusion, but subsequently improved to what was considered her baseline neurological function. Brain MRI performed on HD 29 revealed no evidence of infarct or ischemic injury.
The patient experienced a prolonged hospital stay (>60 days) secondary to medical complications including renal failure, pneumothorax, infection, and upper gastrointestinal hemorrhage.
Discussion: This case highlights several considerations in severe bupropion overdose. It reinforces that bupropion can act as a brain-death mimic, evidenced by the fixed, dilated pupils and decorticate posturing displayed throughout the first week of hospitalization. Another unique finding was the recovered tablets on HD 23 , which represent the insoluble component of bupropion extended-release tablets being excreted in feces. The low level a few days earlier suggests that these tablets did not contain any remaining bupropion.
Conclusion: Large intentional bupropion overdoses can result in seizures and recurrent cardiac arrest. The XL tablet formulation allows for a prolonged release of medication in the gastrointestinal tract that can contribute to ongoing toxicity. Each of these factors warrants the use of aggressive gastrointestinal decontamination measures (ex. activated charcoal,whole bowel irrigation). Furthermore, bupropion can cause a prolonged duration of symptoms that resemble brain death. It is critical for providers to realize this and rely on methods including bupropion/hydroxybupropion concentrations with cerebral imaging techniques to ensure ongoing toxicity is not mistaken for anoxic brain injury.

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117. Mushrooms with "friends" can take your breath away: lycoperdonosis treated with high-flow oxygen and inhaled bronchodilators

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Background: Lycoperdon species mushrooms, commonly referred to as puffball mushrooms, are known to cause pneumonitis following inhalation of spores. Spores are often released in large quantities when the mushrooms are fractured, compressed, or shaken. There is little evidence regarding the best treatment for *Lycoperdon* associated pneumonitis, though steroids and amphotericin B have been recommended by some.
Case report: A 13 year old girl presented to the emergency department in the early fall with complaints of vomiting, fever, cough, tachypnea, tachycardia, and hypoxia requiring 15 L of supplemental oxygen via nonrebreather mask. Chest x-ray revealed bilateral infiltrates consistent with pneumonitis. Her labs were notable for an elevated white blood cell count of 17,000 cells/mm3, CRP of 199.9 mg/L, and a negative COVID-19 PCR. Further history revealed that 4-6 days before presentation she had been investigating some puffball mushrooms with friends when one of them shoved the mushroom into her face whereupon she inhaled several large breaths with spores and other debris. She had begun to experience symptoms as soon as the day of exposure which had worsened over the intervening days leading up to her presentation.
She was admitted to a Pediatric Critical Care Unit and placed on high-flow nasal cannula (10 L/min with 40% fraction of inhaled oxygen). She had been given broad spectrum antibiotics initially which were discontinued after admission. She received treatment while admitted with albuterol via nebulization. She did not receive treatment with corticosteroids. She improved over the following 5 days with decreasing oxygen requirements and less subjective symptoms. She was discharged home on hospital day 5 with no persistent pulmonary symptoms or vital sign abnormalities.
Discussion: Lycoperdonosis is rarely reported. In this case the resulting pneumonitis was severe enough to warrant admission to a critical care unit as well as high flow nasal cannula oxygenation. In this case no corticosteroids were used and the patient recovered quickly without immediately obvious adverse effects. The best use of antifungals, corticosteroids, and inhaled bronchodilators in lycoperdonosis is unclear however this patient did well with only bronchodilators. Progressive respiratory illness has been described in adolescents exposed to these spores in the past. Clinicians should keep this on their differential for progressive respiratory illness, especially in endemic areas.
Conclusion: Inhalation of puffball mushrooms can cause systemic and respiratory symptoms and regional Poison Centers may be asked to give recommendations regarding the optimal treatment of this disease. While there is no consensus on the best medication regimen in our cse an adolescent with a significant exposure and pneumonitis did well without antifungal or corticosteroid treatment.

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118. Iva-BRADY-ine? Characteristics of single agent ivabradine ingestions reported to the NPDS

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Background: Ivabradine was FDA-approved in 2015 and is used to reduce the risk of hospitalization for worsening heart failure in adult patients with stable, symptomatic chronic heart failure with reduced left ventricular ejection fraction and for the treatment of stable symptomatic heart failure due to dilated cardiomyopathy in pediatric patients ages 6 months and older. It's mechanism of action is the antagonisms of the sodium (Na^+) / potassium (K^+) channel intracellularly, thereby inhibiting the mixed Na^+/K^+ currents called funny currents (I_f). Ivabardine exposures have the potential to cause bradycardia and possibly hypotension. However, published medical literature concerning exposures to ivabradine is limited. We sought to describe the characteristic of single agent ivabradine ingestions reported to the NPDS.
Methods: This was a cross sectional study consisting of NPDS data collection utilizing quantitative data for the period of 1/1/2015 to 12/31/2020 to identify all single agent human exposures to ivabradine followed to a known outcome. All data entered into NPDS was collected and analyzed using Microsoft Excel (*Microsoft Corp., Redmond, Washington*, 2010).
Results: A total of 72 cases were identified. The average age was 27 years (range 1 month to 88 yo, SD 20). 28 cases (38%) involved pediatric patients. 56 cases (78%) were female. The highest number of cases were reported in 2019 (n = 22). Moderate medical outcomes were reported in 19 of adult cases and 3 pediatrics cases (30%). There were no major outcomes or deaths reported in either group. The most common reason for exposure was unintentional-general (n = 17) and unintentional-therapeutic error (n = 23) in the pediatric and adult cases, respectively. Eighteen adult cases and 3 pediatric cases were due to intentional exposures. In all, 10 cases (14%) were admitted to a critical care unit. Eighteen adult cases and only 1 pediatric case developed bradycardia. Hypotension was reported in 4 adult cases and no pediatric case. All cases with either bradycardia or hypotension were intentional overdoses. Atropine was given in 2 adult cases. There were no cases of vasopressors being used.
Conclusions: Single agent exposures to ivabradine are rare. Overall, significant morbidity or mortality is lacking, especially in pediatric cases. Bradycardia was common in intentional exposures but did not result in serious medical outcomes.

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119. Fomepizole as an adjunct to NAC in acetaminophen overdose: a case series

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Background: N-Acetylcysteine (NAC) has been the primary treatment for prevention of acetaminophen overdose toxicity for more than 40 years. Patients presenting late after an overdose or following a massive ingestion may still develop hepatotoxicity and even develop fulminant hepatic failure despite the use of NAC. Fomepizole has proven safety in methanol and ethylene glycol poisoning and is a potent CYP2E1 and c-Jun-N-terminal Kinase (JNK) inhibitor. It can reduce the conversion of APAP to NAPQI and prevent other downstream effects during the metabolic phase unlike NAC.
Case series: In our case series of 8 patients presented last year we used fomepizole as an adjunct to IV-NAC in APAP overdose. We report an additional 6 patients who had a greater risk for toxicity from acetaminophen than some previously reported.
Discussion: These cases demonstrate the safety and potential use of fomepizole as an adjunct to IV-NAC in APAP overdose. Peak acetaminophen levels as well as addition of the acetaminophen - ALT product (A*T product) calculations to all 14 cases are shown in the table.
Conclusion: This case series adds to the growing knowledge of fomepizole's safety and potential use in late presenting, delayed and serious cases of APAP overdose.

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120. Comparing clinical features of benzodiazepine and z-drug overdoses: a review of the Toxicology Investigators Consortium registry

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Background: Benzodiazepines and z-drugs (eszopiclone, zaleplon, zolpidem, and zopiclone) are two pharmacologically similar sedative-hypnotic classes encountered by medical toxicologists. Both drug classes produce similar clinical effects via interaction with the benzodiazepine receptor site and are reversible with flumazenil. Little data has been published directly comparing these medications and their clinical effects in toxicity. The objective of this study is to compare frequencies of commonly seen adverse effects and use of treatment strategies between drug classes.
Methods: This is a retrospective review of all available data regarding single-drug ingestions of benzodiazepines and z-drugs entered into the Toxicology Investigators Consortium Registry from January 2010 through December 2020. Frequencies are reported as percentages, and statistical significance was determined using the chi-squared test.
Results: From the available registry data, there were 829 single-drug ingestions of benzodiazepines and 140 single-drug ingestions of z-drugs. Of the 140 cases of z-drugs identified, the majority were zolpidem ingestions (89%). Of the 829 cases of benzodiazepine ingestions, the most commonly ingested drugs were alprazolam (36.5%), clonazepam (33.9%), and lorazepam (17.9%).
When comparing clinical features of benzodiazepine ingestions to z-drug ingestions, there was no significant difference between rates of central nervous system (CNS) depression (64.9% vs 68.6%; p = NS), respiratory depression (9.0% vs 8.4%; p = NS), endotracheal intubation (7.7% vs 9.3%; p = NS), bradycardia (2.5% vs 1.4%; p = NS), or hypotension (2.7% vs 5%; p = NS). Our data did demonstrate a significant difference in rates of administration of flumazenil between benzodiazepine ingestions and z-drug ingestions (11.7% vs 5.0%; $p < 0.05$).
Discussion: Both benzodiazepines and z-drugs can result in CNS and respiratory depression, need for endotracheal intubation, and, rarely, bradycardia and hypotension. Our data suggests that the frequencies of these outcomes are similar in single-drug ingestions of both types of drugs. While flumazenil has been shown to reverse toxicity of both medication classes, our data indicate its use is significantly less frequent in z-drug overdoses compared to benzodiazepines, even in the setting of similar rates of CNS depression and intubation.
Conclusion: Clinical effect profiles of benzodiazepines and z-drugs are similar. Despite this, flumazenil may be underutilized in z-drug overdoses compared to benzodiazepine overdoses.

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121. Determination of risk factors associated with toxic alcohol ingestion

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Background: Ethylene glycol (EG) and methanol (MeOH) laboratory assays are not readily available in many hospitals. Most providers use surrogate markers such as the osmol gap to identify toxic alcohol (TA) ingestion. When the gap is significantly elevated (> 30) and a history of TA ingestion is reported, the diagnosis is clear. Unfortunately, there are multiple causes of mildly elevated osmolar gap (10 – 30), with only about 20% being due to TA ingestions. The purpose of the study is to identify prognostic factors to determine whether a patient's acidosis is secondary to a TA ingestion.
Methods: This was a retrospective chart review of all cases from 1/1/2010 to 12/31/2019 reported to a single poison center. Cases were screened if EG or MeOH was coded as a substance or as a laboratory concentration, substance verbatim included "antifreeze" or other similar TA sources, or the notes contained "AKA" or "ketoacidosis". Cases were included if a TA concentration was reported in the notes or coded into the medical record (including cases where the concentration was determined to be zero). Only the initial laboratory data and history were used to identify predictive factors. Descriptive statistics were used for frequency and median of study population. Bivariate analysis was conducted to detect any associations between the outcome and characteristics using chi-square test or Fisher's exact test for categorical variables and Wilcoxon rank-sum test for continuous variables. A simple logistic regression was performed for calculating odds ratios with 95% confidence interval and propensity scores. Analyses were performed with SAS version 9.4 (SAS Institute, Cary, NC).
Results: The final population included 362 cases over the 9-year period with a median age of 43 (IQR 27-54) and 68.5% male. The median initial anion gap was 21 mEq/L (IQR 15-30) with an osmolar gap of 25 (IQR 16.7-49) and a pH of 7.2 (IQR 7.0-7.4). Ethanol (EtOH) was positive in 34.7% (83/239) cases where it was reported and ≥100 mg/dL in 27.4% (60/239). A reported history of TA ingestion was associated with presence of a TA (OR =5.31, 95% CI:3.25-8.65). Positive EtOH (OR =0.36, 95% CI =0.2-0.65) and an EtOH ≥100 (OR =0.33, 95% CI =0.17-0.64) were both associated with a decreased likelihood of TA ingestion in bivariate analyses. An osmol gap of greater than 20 had an OR =3.97 (95% CI =1.84-8.53) and an osmol gap of greater than 30 had an OR =6.0 (95% CI =2.81-12.8) of being due to a TA. If there is no report of a TA ingestion, and the EtOH was positive, the likelihood of a toxic alcohol being the cause of acidosis is exceedingly low (OR =0.07, 95% CI =0.009–0.56). The OR was lower if the EtOH concentration ≥100 (OR =0.05, 95% CI =0.003–0.89).
Conclusion: The reported history of toxic alcohol ingestion paired with an EtOH concentration (any positive but especially ≥100 mg/dL) provided the best negative predictor of whether a patient's acidosis is secondary to a toxic alcohol exposure.

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122. Esophageal perforation linked to kratom exposure

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Background: Kratom (Mitragyna speciosa) is a plant in the coffee tree family that is native to Southeast Asia. It contains the active components mitragynine and 7-OH-mitragynine which at low doses have stimulant properties, and higher doses agonize opioid receptors. Although traditionally used in Southeast Asia to

combat fatigue and improve work productivity, its use in the United States has primarily been as an opioid alternative. Vomiting has been reported in 11.2% of kratom exposures reported to the National Poison Data System. We describe a case of kratom use resulting in excessive vomiting and esophageal perforation.

Case report: A 33-year-old previously healthy male arrived in the emergency department after kratom use. His initial symptoms consisted of nausea, muscle spasms, non-specific flank and abdominal pain, and shortness of breath. He had a history of kratom use and reported ingesting kratom that evening. He was given a dose of activated charcoal by emergency medical services en route due to a potential toxic ingestion. On arrival, vital signs included heart rate 110 beats/min, blood pressure 125/86 mmHg, respiratory rate 24 breaths/min, oxygen saturation of 97% on room air, and a temperature of 99.7 °F. He was very anxious on arrival and required 2 mg of intravenous lorazepam. The patient then noted that he had multiple episodes of profuse vomiting prior to arrival. At presentation, he was diaphoretic and had an additional episode of vomiting in the ED. A computed tomography (CT) scan of the chest and abdomen was performed which found a perforated esophagus and extravasation 3 cm above the gastro-esophageal junction. The patient was started on empiric antimicrobial coverage and prepared for surgical repair. However, the patient adamantly refused the procedure, so a chest tube was placed to allow for drainage. He continued to have a low-grade fever and refused other interventions. He left against medical advice on hospital day 3.

Discussion: The esophageal perforation was likely due to severe vomiting. Kratom use has been associated with a high rate of vomiting even with initial exposure to the substance. This can be refractory to multiple antiemetics. Although there is a history of kratom ingestion, there are no confirmatory concentrations of mitragynine or metabolites. Therefore, it is difficult to ascertain whether this was secondary to true use of kratom, or another substance marketed as kratom.

Conclusion: This is a case of esophageal perforation after excessive vomiting following reported kratom use. While this may be difficult to interpret without confirmatory concentrations, toxicologists should be aware of the risk of refractory vomiting with kratom use leading to pain, bleeding, and possibly esophageal rupture.

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123. Fatal massive acetaminophen overdose with serum level of 1,477 MCG/ML

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Background: We report an acetaminophen level of 1,477 mcg/mL that resulted in death. We believe this to be among the highest levels reported in the literature to date.

Case report: A 24-year-old woman was found unresponsive next to a bottle of acetaminophen tablets 14 hours after last being seen. She presented in cardiovascular collapse and was resuscitated with 3 liters of crystalloid, started on a norepinephrine infusion, and intubated soon after arrival. Initial workup was notable for: pH 6.93, pCO_2 9.6 mmHg, HCO_3 2 mEq/L, lactate 17.4 mmol/L, AST 347 units/L, ALT 302 units/L, and serum acetaminophen 1,477 mcg/mL. Urine drug immunoassay was positive for benzodiazepines only. Intravenous n-Acetylcysteine was started with a loading dose of 150 mg/kg, followed by continuous infusion of 25 mg/kg/hour. Immediate hemodialysis was advised but was unavailable at the initial facility.

Approximately six hours later, the patient arrived at a large, tertiary care facility. She was unresponsive without sedation, with norepinephrine, vasopressin, and dopamine infusing. She remained acidemic with pH 7.02 despite bolus doses of sodium bicarbonate. Fomepizole 15 mg/kg was administered. A dialysis catheter was placed, but the patient was thought to be too hemodynamically unstable to tolerate intermittent hemodialysis. High-flux CVVHD was attempted, but this immediately resulted in worsening hypotension followed by ventricular tachycardia and cardiac arrest that temporarily responded to epinephrine, amiodarone, and lidocaine. She developed worsening cardiogenic shock, persistent metabolic acidosis, hyperammonemia, and disseminated intravascular coagulation with incalculably high coagulation markers. She became acutely anemic and required multiple units of packed red blood cells. The family declined further treatment and the patient died 23 hours after initial presentation.

Discussion: Serial acetaminophen levels requiring dilution were 1,477 mcg/mL at time 0, 773 mcg/mL at 11.5 hours, and 587 mcg/mL at 20.5 hours. Elimination half-life is estimated at approximately 12 hours. It is unknown whether the reported level of 1,477 mcg/mL reflects the peak level. To estimate the acetaminophen dose required to achieve this plasma level, we used bioavailability of 80%, V_D of acetaminophen as 0.9 L/kg, and measured patient weight of 72 kg. This suggests upwards of 120 grams of acetaminophen would be required to achieve a level of 1,477 mcg/mL. It is noteworthy that the bottle of acetaminophen found near the patient was later reported to be a 250-count bottle of acetaminophen 500 mg with six tabs remaining.

Acute mitochondrial dysfunction with associated metabolic acidosis, shock, and altered mental status is prominent in massive acetaminophen poisoning. Hyperammonemia and coagulopathy may precede major hepatotoxicity. N-Acetylcysteine will not interrupt mitochondrial toxicity.

Hemodialysis is a viable option in massive ingestion, although n-Acetylcysteine dosing requires appropriate adjustment as it is subject to dialysis.

Conclusion: This case details the natural history and physiologic derangements that manifest during massive acetaminophen poisoning. It may be appropriate to prioritize early hemodialysis and toxin removal first, rather than transfer to a transplant center. Regardless, in delayed presentation with multi-system dysfunction apparent, patients may not tolerate this procedure.

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124. Self-harm exposures in pregnant and non-pregnant cases reported to US poison centers: a case-control study

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Background: Self-harm during pregnancy represents a small percentage of cases at U.S. poison control centers. There is limited literature describing self-harm poisonings in pregnant women, especially with comparisons to non-pregnant controls. The purpose of this study was to analyze data of pregnant self-harm poisonings compared with non-pregnant controls including trends

over time, age of patients, severity and outcome, level of care, and what substance(s) were involved.
Methods: The National Poison Data System was queried for all exposures in pregnant women from 15 to 45 years of age from 2000 through 2019. Additionally, an age matched control group of non-pregnant cases was provided in a ratio of 5:1 non-pregnant to pregnant for the study period. This analysis is limited to cases of suspected self-harm (i.e., intentional-suspected suicide). Comparisons are presented as median and interquartile range (IQR) or odds ratio (OR) and 95% confidence intervals (CI) as appropriate.
Results: Overall there were 131,619 pregnant cases and 658,095 non-pregnant controls, with 32,212 cases and 207,593 controls identified as 'intentional-suspected suicide'. The median and interquartile age was 25 years (IQR: 21-30) and the pregnant cases (23 years) were younger than non-pregnant controls (26 years). There was a small increase in the overall number of self-harm cases over time. The proportion of all pregnant cases that were due to self-harm did not increase over time (14.9% to 15.9%; $p = 0.097$), but the non-pregnant controls increased (26.6% to 34.2%; $p < 0.001$). Pregnant case exposures more frequently involved any analgesics (e.g., opioids, non-steroidal anti-inflammatory drugs, acetaminophen) (36.1% vs 31.2%; OR: 0.804, 95% CI: 0.784-0.824) or specifically acetaminophen (22.6% vs 18.6%; OR: 0.786, 95% CI: 0.764-0.808), and less likely involved sedatives (38.2% vs 48.6%; OR: 1.53, 95% CI: 1.50-1.57) or drugs of abuse (10.4% vs 15.3%; OR: 1.55, 95% CI: 1.49-1.60). No effect and minor effect accounted for 61.1% of medical outcomes for these self-harm episodes. Cases were more likely to be admitted (49.3% vs 43.9%; OR 1.24, 95% CI: 1.21-1.27), but also less likely to have a severe outcome (moderate, major, or death) compared with controls (26.9% vs 28.1%; OR 0.94, 95% CI: 0.91-0.96). The cases were more likely to be admitted to the intensive care unit than the non-pregnant controls (27.4% vs 25.5%; OR: 1.10, 95% CI: 1.07-1.13).
Conclusions: There has been an increase in the proportion of self-harm attempts amongst non-pregnant female cases reported to US poison centers. This increase was not observed in pregnant cases. Severe outcomes occurred in approximately 27% of all exposures and almost half were admitted to the hospital, with small, but statistically significant differences between pregnant and non-pregnant cases.

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125. Use of natural language processing text-mining for identification of similarities and differences in the "overdosage" section of drug labeling

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Background: The OVERDOSAGE section of labeling of different drugs with the same active ingredient typically has similar language; however, important differences may exist (e.g., due to differences in the conditions of use of the drugs). A manual review of the OVERDOSAGE section of labeling for a specific active ingredient to identify differences is often labor intensive. Natural Language Processing (NLP) text-mining tools may facilitate the process of identifying similarities and differences in the OVERDOSAGE section of labeling with drugs with the same active ingredient. A test case to evaluate the ability of an automated NLP text mining tool to search a labeling database, identify and extract targeted information from the OVERDOSAGE section of labeling, generate structured output, and analyze for similarities and differences in the wording in the OVERDOSAGE section of labeling for a specific active ingredient was performed.
Methods: A query was developed using the text-mining platform, Linguamatics. The query searched the OVERDOSAGE section of drug labeling with the same active ingredient (identified by its Unique Ingredient Identifier (UNII)) using structured product labeling files in DailyMed. Subsequently, the wording in the OVERDOSAGE section of the labeling for this active ingredient was searched and analyzed for similarities and differences.
Results: The query retrieved 48 different labeling [Physician Labeling Rule (PLR) format and non-PLR format labeling] for drugs with the active ingredient including 38 fixed combination drug products (containing the active ingredient and at least one additional active ingredient) and 10 single ingredient products. Among 48 labeling, 17% were for prescription drugs approved under New Drug Applications (NDAs) and 83% were for prescription generic drugs approved under Abbreviated New Drug Applications (ANDAs). Of the 8 labeling under NDAs, 6 had different content in the OVERDOSAGE section. Of the 40 labeling under ANDAs (generic drug labeling), two sets of labeling with different content in the OVERDOSAGE section were identified.
Conclusions: Natural Language Processing text mining can be used to query labeling in DailyMed and identify the differences in the OVERDOSAGE section labeling for a specific active ingredient.

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126. Extracorporeal membrane oxygenation: rescue therapy in pediatric bupropion cardiotoxicity

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Background: Bupropion is a unique norepinephrine and dopamine reuptake inhibitor. In toxicity, these mechanisms conspire with presumed gap junction blockade, producing wide complex tachydysrhythmias, cardiogenic shock, and seizures similar to those associated with sodium channel antagonists. Although not commonly prescribed, bupropion ranks first among antidepressant fatalities reported to US Poison Centers and accounts for 3% of poison patients treated with extracorporeal life support (ECMO). Given limited data regarding the utility of ECMO for severe bupropion toxicity in pediatric patients, we present a retrospective cohort.
Methods: Study setting and design: Retrospective cohort of patients $\leq$18 years of age reported to a Regional Poison Control System (PC) between 1/1/2000 and 3/31/2021 for whom ECMO was performed for severe bupropion toxicity. Selection of Participants: All cases $\leq$18 years of age reported to PC for bupropion exposure, coded as receiving ECMO. Cases were identified via search of the Toxicall® database, and excluded if ECMO was unrelated to bupropion. Data Analysis: Clinical presentation, emergent management, and critical care including ECMO are presented as descriptive statistics.
Results: During the study period, 4,951 bupropion exposures were reported to the PC; of these, 1,145 (23.1%) were pediatric patients. Nine patients were coded as undergoing ECMO, and of

these four (44.4%) were ≤18 years of age (median 16, range 14-17). Median time from ingestion to presentation was 2.25 hours (range: 1-3.5). Median first vital signs were systolic blood pressure 100mmHg (range: 70-124); pulse 119.5 (range: 70-175). Early reports of temperature, respiratory rate, and oxygen saturations to the PC were uncommon. Median time from ingestion to ECMO was approximately 17.625 hours (range: 7.25-33.75); median vasopressors required were 2.5 (range: 2-3). All experienced multiple seizures and ventricular dysrhythmias with systolic hypotension. Three of four patients experienced cardiac arrest. All but one required transfer to an ECMO-capable facility for definitive cares. Three patients survived with full neurologic recovery; one died.

Discussion: Over 20 years, pediatric bupropion cases requiring ECMO were rare, with most occurring in the last four years. All cases presented with wide complex dysrhythmias and progressive hemodynamic instability, all sustained multiple seizures, and three sustained cardiac arrest. Both the time to ECMO and the duration of EMCO support warrant notice, given that variable hemodynamic instability - despite maximal pressor therapy - may both delay ECMO initiation and confound clinical course.

Limitations: As with other PC-based studies, incomplete reporting of data such as vital sign changes paint an incomplete picture of illness severity and efficacy of interventions, and may introduce anchoring bias or incompletely represent the clinical course of disease. Detailed chart review was undertaken in an attempt to mitigate this.

Conclusion: In this cohort of severe pediatric bupropion poisonings, ventricular arrhythmias and seizures were common. Despite prolonged ECMO courses, favorable outcomes occurred. Bupropion is a potentially lethal toxin underappreciated outside of medical toxicology. It is incumbent on Poison Centers and medical toxicologists to identify cases that may require ECMO, and to educate prescribers and pediatricians on the potentially deadly toxidrome associated with bupropion.

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127. Alarming increase in suicide attempts in children and adolescents during the COVID-19 pandemic reported to a National Poisons Information Centre

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Background: In our country restrictions because of the COVID-19 pandemic were introduced on March 16, 2020 and gradually removed until June 2020. Because of the second wave restrictions were reintroduced in October 2020, with gradual removal starting in the mid of April 2021. During the periods of restriction gatherings of more than five people were forbidden, schools were completely or partly closed and many facilities such as youth centres, sport facilities, cinemas and shops were closed. The possibilities to meet other people were very limited, a situation that can stress mental health especially in children and adolescents. The aim of our study was to evaluate whether there was an increase of suicide attempts by intoxication among children and adolescents in our country during COVID-19 restrictions of the second wave.

Methods: We conducted a retrospective study of the number of calls to our national poisons information center regarding suicide attempts. We looked at six different time periods, each from January to April, in the years 2016-2021. We compared the number of calls from 2016-2020 to the number of calls in 2021 among children and adolescents <19 years and adults ≥19 years. Furthermore, we conducted a subgroup analysis in the <19 years old. We defined seven categories of age (<13, 13-<14, 14-<15 years, etc.) and compared the number of calls in these categories from 2016-2020 to the year 2021.

Results: During the six time periods 1333 calls were recorded in <19 years old, 4607 in ≥19 years old. We saw a 1.7 fold increase in the calls concerning <19 years old comparing the years 2016-2020 to 2021 (n = 192, 204, 206, 205, 187, 339, respectively from 2016-2021). No increase was seen in ≥19 years old (n= 846, 766, 762, 736, 751, 746, respectively from 2016-2021).

Of the 1333 cases in <19 years old 1127 patients were female (85%), 205 male, sex was not recorded in one 18-year-old. Of the 4607 cases in ≥19 years old 3115 patients were female (68%), 1490 male, sex was not recorded in a 36- and a 38-year-old.

Looking at the subgroups of calls concerning <19 years old, the increase of suicide attempts was over proportional in the younger age groups of <15 years old, with a 2.1, 2.7 and 1.8 fold increase in <13, 13-<14, and 14-<15 years, respectively.

Conclusions: We found a 1.7 fold increase in the number of calls because of suicide attempts in <19 years old during the first four months of 2021 compared to the same time periods in the previous five years. No such increase was found in ≥19 years old. This increase of suicide attempts by children and adolescents during the second lockdown could be directly related to the pandemic situation with its major restrictions in social life. Of particular concern is the increase of suicidal attempts by children aged <15 years and the high percentage of suicide attempts by girls in the <19 year olds.

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128. Bleeding complications of massive apixaban overdose successfully treated with prothrombin complex concentrate in a pediatric patient

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Background: Apixaban is a potent direct-acting oral anticoagulant (DOAC) that functions via selective, reversible binding of factor Xa. Due to a superior safety profile versus warfarin, it is an increasingly popular agent for treating thromboembolic disease and atrial fibrillation. A previous study has described infrequent bleeding complications from apixaban overdose, and no bleeding occurring from acute overdoses of apixaban by children.

Case report: An 84.1 kilogram, 16-year-old female with previous suicide attempts presented to the emergency department approximately 2 hours following reported intentional ingestion of sixty 5mg apixaban tablets prescribed to her mother. Initially, the patient was asymptomatic. Her physical exam was significant for a heart rate of 104, blood pressure of 131/73 mmHg, and no bruising or active bleeding despite multiple superficial lacerations from recent self-harm. 50 grams of activated charcoal were administered. Initial laboratory testing was notable for a hemoglobin of 12.8 g/dL (reference 12-15 g/dL), PT of 29.5 seconds

(reference 12.4-14.6 seconds), PTT of 53.8 seconds (reference 23.8-35.0 seconds), INR of 2.70, and a serum apixaban level of 2600 ng/mL (reference 663.2-707.2 ng/mL following ingestion of 50mg in healthy controls). While in the emergency department, the patient developed gross hematuria confirmed by urinalysis showing greater than 50 RBCs/HPF (reference 0 RBCs/HPF) and was admitted for further monitoring.
On admission, the patient experienced self-limited epistaxis, continued gross dark-brown hematuria, and developed dull flank and right upper-quadrant abdominal pain. An anti-Xa level was found to be >1.10 IU/dL (therapeutic range for unfractionated heparin 0.35-0.7 IU/dL). Due to ongoing bleeding and laboratory evidence of coagulopathy, 2000 units of Prothrombin Complex Concentrate (PCC) was given. The patient's hematuria subsequently resolved, with repeat labs showing an anti-Xa level of 0.46 IU/dL, PT 13.4 seconds, INR of 0.99, and hemoglobin of 13.0 g/dL. She was discharged to a psychiatric facility on hospital day 2 with no further incident.
Discussion: Most likely due to the safety profile of DOACs, prior literature describing acute overdose of these agents has shown bleeding complications to be a rare, particularly in children. Additionally, previous literature has suggested a lack of correlation between clinical bleeding tendency and laboratory parameters such as PT and INR. In this case, perhaps owing to the massive nature of the ingestion, marked elevation in both assays was a prelude to an unusual sequela of acute apixaban ingestion: clinically significant bleeding.
This case was also notable for the use of PCC. Modified recombinant factor Xa (Andexanet alfa) is the preferred agent for treating bleeding secondary to Xa inhibitors. However, it is costly (roughly five times as expensive as PCC) and availability may be limited, particularly in pediatric facilities. Herein, use of PCC successfully resolved both clinical and laboratory manifestations of coagulopathy without incident.
Conclusions: While rare, bleeding diathesis is a potential complication of pediatric apixaban overdose, and observation for complications is warranted following massive DOAC ingestion. There may be a role for coagulation studies in identifying patients at risk for bleeding in apixaban toxicity, and PCC should be considered as a potential treatment if persistent bleeding occurs.

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129. Use of South African polyvalent equine antivenom in a late presenting African spitting cobra envenomation

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Background: The African Spitting Cobra (genus: Naja) is indigenous to sub-Saharan Africa, and envenoming can lead to necrosis and gangrene. This elapid retains typical neurotoxic and hemotoxic properties, but is predominantly cytotoxic. Venom spitting and bite envenomation can deliver cytolytic venom. We report a case of a late presenting envenomation with significant and progressive symptoms.
Case report: A 21-year-old (snake handler-in-training) presented 48 hours post envenomation by an African Spitting Cobra with increased edema of his arm. He was bit on his left dorsal forearm and endorsed systemic clinical manifestations including "high" fevers, nausea, vomiting, dyspnea, chest pain, and 1 syncopal episode prior to emergency department (ED) arrival. Arrangements were made to transfer the patient to the regional tertiary care center for treatment. He signed out against medical advice prior to transfer and 12 hours later presented to the tertiary care center. He was tachycardic (HR 154) on presentation and his labs (day 3) were significant for platelets 156, fibrinogen 713, and INR 2.1. A medical toxicology consult was provided and FDA expanded access use for antivenom was obtained. The patient received 5 vials of S.A.I.M.R. polyvalent antivenom (equine derived $F(ab^1)_2$ antibodies) over one hour. Despite epinephrine pre-dosing he developed an anaphylactic reaction which was managed with epinephrine, diphenhydramine, famotidine, and methylprednisolone. He was given ondansetron and hydromorphone. The antivenom halted the progression of his local symptomatology and a reduction in edema was noted. On day 4, he had continued improvement of local symptoms and resolved systemic symptoms. Labs revealed a D-dimer of 17.55, platelets 86, fibrinogen 805, INR 1.3 and CPK 6,237. On day 5, he had further improvement of local symptoms and his labs included a D-dimer of 2.23, platelets 59, fibrinogen 927, INR 1.1, CPK 1,437, factor V 209 and factor VIII of 451. Despite the hospital team's recommendations the patient left against medical advice (AMA).
Discussion: The South African polyvalent antivenom is effective against venoms of mambas, cobras, vipers, and rinkhals. The African Spitting Cobra is a medically relevant elapid whose venom is a complex mixture of enzymes, proteins, metalloproteinases, phospholipases and three-finger toxins. Despite pre-treatment with epinephrine the patient had an anaphylactic reaction, a known complication of antivenom. The patient had prior documented snake envenomations (from copperheads and other unknown snakes) and self-discharge AMA reported to the poison control center. This is not an uncommon finding in snake handlers, however, the likelihood to make immunogens to multiple bites in this population is unclear. He had a self-reported history of 16 copperhead bites. Prompt consultation with a medical toxicologist and initiation of the South African polyvalent antivenom helped achieve control in this late presenter. While he gradually improved over 2 days post antivenom he left AMA before resolution of his symptoms. No resurgence of his anaphylactic reaction occurred during his hospital stay.
Conclusion: This case demonstrates despite his late presentation post envenomation by the African Spitting Cobra, the South African polyvalent antivenom was effective in halting and improving local and systemic symptoms.

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130. Colchicine suicide with antemortem blood concentration

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Background: Cases of intentional colchicine ingestions managed by poison control centers are comparatively rare, with only 921 total cases from 2000 through 2020, with 104 major outcomes and 79 deaths. We report the case of an adult death from intentional colchicine ingestion with an antemortem colchicine concentration.
Case report: An otherwise healthy 70 kg adult between 21 and 65 years of age presented to the Emergency Department with abdominal pain. Several hours later the patient told the ED staff they had ingested an unknown prescription medication approximately 15 hours before presenting to the ED. The patient's friend found the empty prescription medication bottle which was a new prescription for 30 tablets of colchicine 0.6 mg. The patient was initially treated with antibiotics, antiemetics, opioid analgesics and IV fluids. Laboratory studies from around the time the patient presented to the ED, approximately 15 hours post-

ingestion, were reported as "normal." On hospital day 2 the patient was intubated for shock and multisystem organ failure, and was also started on norepinephrine and IV n-acetylcysteine. Multiple dose activated charcoal was considered but could not be performed because of an ileus. CRRT was initiated for worsening renal function, acidosis and electrolyte abnormalities. Hypotension prevented the use of regular hemodialysis. On hospital day 3, epinephrine, vasopressin and stress-dose steroids were added. EEG showed diffuse cerebral dysfunction. CT scan revealed reactive ileus, over distended stomach and thickened gallbladder wall. Despite progressively more aggressive supportive care, the patient's clinical course followed the phases classically described for colchicine toxicity and the patient died on hospital day seven approximately 165 hours post-ingestion.
Ante-mortem blood obtained approximately 18.5 hours after the colchicine ingestion had a colchicine concentration of 14 ng/mL. Autopsy revealed multifocal areas of necrosis in the lungs, GI tract, kidney and liver.
Discussion: Scientific literature reports that therapeutic dosing of colchicine leads to a peak serum concentration within 1-2 hours post-ingestion. The highest peak colchicine concentration reported from a 1 mg dose in an adult was 8.52 ng/mL at 1 hour. Colchicine concentration at 24 hours after a therapeutic dose of 1 mg is approximately 0.38 ng/mL. Case reports of adult colchicine overdoses reported the following ante-mortem colchicine concentrations: 21 ng/mL at 6.25 hours after ingestion of 7.5 mg (0.125 mg/kg), 29 ng/mL at 22 hours after ingestion of 30 mg (0.31 mg/kg), and 9.5 ng/mL at 24 hours after ingestion of an unknown quantity. With our decedent, ingestion of 18 mg of colchicine (approximately 0.26 mg/kg) produced an ante-mortem colchicine concentration of 14 ng/mL.
Conclusion: The case report provides an ante-mortem blood colchicine concentration from an intentional ingestion of a known amount of colchicine at a specific time that led to the patient's death.

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131. Reactive hypoglycemia during treatment of sulfonylurea overdose

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Background: Hypoglycemia resulting from sulfonylurea overdose has been well-described in the literature. Sulfonylurea-induced hypoglycemic episodes treated with intravenous D50 can result in a phenomenon similar to postprandial reactive hypoglycemia, which has also been described in the literature. Refraining from high-concentration dextrose boluses for treatment of hypoglycemia in hospitalized patients decreases glycemic variability and recurrent episodes of hypoglycemia. Treatment and prevention of hypoglycemic episodes with lower concentrations of IV dextrose or oral intake effectively mitigates recurrent hypoglycemia in sulfonylurea overdose. We present a case of reactive hypoglycemia due to multiple doses of D50 successfully managed by continuous infusion of D10 and octreotide.
Case report: A 42-year-old woman with type 2 diabetes presented to the emergency department by EMS after an intentional overdose of glyburide. EMS assessment noted the patient was confused, responsive only to painful stimuli, and had slurred speech. Her initial blood glucose was 60 mg/dL, for which paramedics administered an IV bolus of 25 g D50. Upon ED arrival POC blood glucose was 154 mg/dL. Approximately two hours later, her blood glucose decreased to 20 mg/dL. She was treated with another 25 g IV bolus of D50. A POC glucose obtained 90 minutes later was 51mg/dL. Repeat blood glucose one hour later was 20 mg/dL. The patient was then started on a D10 infusion. Her repeat POC glucose was <20 mg/dL. The D10 infusion rate was then increased, and 120 mcg octreotide was administered subcutaneously. Glucose immediately improved to 172mg/dL, and subsequent levels remained stable on D10 infusion at 50 ml/hr along with octreotide 50mcg subcutaneously every six hours.
Discussion: Patients who overdose on insulin secretagogues (sulfonylureas or meglitinides) are at risk for developing life-threatening hypoglycemia. Sulfonylureas increase insulin release and suppress gluconeogenesis and glycogenolysis resulting in hypoglycemia that may be severe and refractory to treatment with dextrose. The goal of treating hypoglycemia is to normalize plasma glucose (>70 mg/dL) without overshooting or stimulating insulin release. Glucose is the most potent stimulus of insulin release, and insulin's primary role is to stimulate glucose uptake. At blood glucose levels <70 mg/dL, insulin is not secreted; above this threshold, insulin is secreted in proportion to circulating glucose. Reactive hypoglycemia may result from the rapid secretion of preformed insulin and increased insulin synthesis. Glucose uptake from the GI tract, gluconeogenesis, and boluses of parenteral (exogenous) glucose can stimulate insulin secretion leading to hypoglycemic episodes. Therefore, when concentrated solution of dextrose such as D50 are used as monotherapy for treatment of sulfonylurea overdose, IV dextrose bolus may precipitate insulin release, triggering reactive hypoglycemia. D50 has other potential adverse effects such as hyperosmolar syndrome and hypokalemia.
Conclusions: Bolus D50 administration for treatment of hypoglycemia in sulfonylurea overdose can precipitate reactive hypoglycemia, complicating the care of these patients. D10 increases blood glucose levels while reducing hyperglycemic episodes that may trigger additional release of insulin. To minimize reactive hypoglycemia in sulfonylurea overdose, D10 bolus and infusion should be considered first-line, with addition of octreotide to assist in maintaining euglycemia.

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132. Intentional adolescent exposures reported to a single poison center in pre-COVID and post-COVID eras

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Background: During the last decade there has been an increase in intentional pediatric ingestions with suicidal intent, particularly in adolescents. Recent data have found that there have been increases in the proportion of emergency department visits for suicidal ideation and suicide attempts since the beginning of the novel coronavirus SARS-CoV-2 (COVID-19) pandemic, but these data did not describe the method of suicide attempt. There are also varying data on intentional drug misuse or abuse in adolescents since the beginning of the COVID-19 pandemic. This study aims to describe patterns of intentional adolescent ingestions reported to a single poison center after the COVID-19 pandemic started in comparison to the pre-COVID-19 era.
Methods: This was a retrospective cohort study using local poison center data. Cases of intentional adolescent exposures reported to a single poison center between March 5, 2019 and March 6, 2021. Adolescents were defined as age 10-19 years old.

Ingestions that were reported from March 5, 2019 to March 5, 2020 were placed in the pre-COVID-19 group and ingestions that were reported from March 6, 2020 to March 6, 2021 were placed in the post-COVID-19 group. March 6th was chosen as the cutoff date as this is the date of the first confirmed case of COVID-19 in the state where the poison center is located. Exclusion criteria included cases that were coded as confirmed non-exposure during the time frame, as well as those that were coded as indirect deaths. Medical outcomes were defined according to the American Association of Poison Control Centers NPDS coding manual. R/R studio were utilized to compare the groups during the pre- and post- COVID time frames.

Results: There was a non-significant decrease in number of intentional adolescent exposures reported in the post-COVID-19 group, 3,300, compared to the pre-COVID-19 group, 3,340 ($p = 0.62$). Major, Moderate, and Death (MMD) medical outcomes were coded in 23.86% of the pre-COVID-19 group compared to 26.64% of the post-COVID-19 group. MMD outcomes were statistically significantly higher in the post-COVID-19 group compared to the pre-COVID-19 group when compared against non-MMD cases ($p = 0.01$). The proportion of ingestions that were suspected suicide increased from 76.44% in the pre-COVID-19 group to 82.79% in the post-COVID-19 group (p-value <0.001 when compared to all other intentional reasons). Conversely, the proportion of ingestions related to misuse or abuse decreased from 21.78% in the pre-COVID-19 group to 14.91% in the post-COVID-19 group ($p < 0.001$).

Conclusions: While there was a non-significant difference in the number of reported adolescent intentional exposures in the post-COVID-19 era, the composition of the reported ingestions changed significantly. A significantly greater proportion of reported intentional ingestions in adolescents were due to suicide attempts in the post-COVID-19 era compared to the pre-COVID-19 era. Additionally, there were significant differences in the proportion of MMD outcomes compared to the number of non-MMD cases reported in the post-COVID-19 era compared to the pre-COVID-19 era. These data bring to question the positive effect social interaction has on mental health, as well as its implications for drug use and misuse in the adolescents.

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133. Impact of the COVID-19 pandemic on pediatric suspected-suicide calls to two poison control centers

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Background: The COVID-19 pandemic has had a significant impact on the mental health of youth and its effect on suspected-suicide calls to Poison Control Centers (PCCs) is unknown. The objective of our study was to examine changes in calls for suspected suicide in children and adolescents during the COVID-19 pandemic compared to a similar pre-pandemic period.

Methods: Aggregated data for calls for all exposures in youth aged 6-19 years reported to two PCCs in one state from March 2017-February 2021 were abstracted from the National Poison Data System (NPDS) Dashboard. Of all calls to the PCCs, the proportion of calls for intentional suspected suicide from March 2017-February 2020 (pre-pandemic) was compared to March 2020-February 2021 (pandemic) in two age groups (6-12y and 13-19y). Outcome severity and substances involved were also compared. Data are described using descriptive statistics and the difference in proportions with 95% confidence intervals (CI) were used to assess for differences between the two study periods.

Results: The number of total calls and number of calls for suspected suicide for youth 6-19 years old were 42608 and 10227, respectively, in the pre-pandemic period, and 12178 and 3558, respectively, in the pandemic period. For children 6-12y, the proportion of calls for suspected suicide increased from 3.1% (601/19614) in the pre-pandemic period to 5.4% (279/5207) in the pandemic period, a 2.3% difference (95% CI: 1.6%-3.0%), representing a 74.2% (95% CI: 50.7%-98.8%) relative increase. For adolescents 13-19y, the proportion of calls for suspected suicide increased from 41.9% (9626/22994) in the pre-pandemic period to 47.0% (3279/6971) in the pandemic period, a 5.1% difference (95% CI: 3.7%-6.5%), representing a 12.2% (95% CI: 8.9%-15.5%) relative increase. These increases were seen despite a decrease in total call volumes in the pandemic period. For both age groups, the proportion of calls for suspected suicide were consistently higher than in previous years from October 2020 to the end of the study period. Compared to pre-pandemic years, both age groups had a greater proportion of suspected suicide calls with outcomes categorized as major or death during the pandemic year, though this was only significant for the older age group (1.0% difference (95% CI: -1.1%-3.1%), for 6-12y; and 0.8% difference (95% CI: 0.2%-1.5%) for 13-19y). Ibuprofen and acetaminophen were the top substances reported in calls for suspected suicide in both study periods, with an increase in the proportion of calls for these substances combined during the pandemic period (27.8% pre-pandemic vs 30.9% pandemic; relative increase 11.2% (95% CI: 4.7%-17.7%)).

Conclusions: The proportion of calls to two PCCs for suspected suicide in youth significantly increased during the COVID-19 pandemic, with worse clinical outcomes in adolescents 13-19-years-old than in pre-pandemic years. The top substances involved remain over-the-counter medications. Improved suicide prevention efforts, including universal behavioral health screening and access to mental health care, as well as continued education on the potential dangers of over-the-counter medications and importance of safe medication storage, are urgently needed for this vulnerable population.

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134. A bridge to somewhere: treating caffeine toxicity from massive guarana ingestion with ECMO as a bridge to hemodialysis

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Background: Caffeine toxicity is known to cause hemodynamic collapse and refractory arrhythmias, with concentrations as low as 80 micrograms per milliliter being fatal. Traditional recommendations for overdose include intravenous beta-blockers, but this may not be practical in the setting of cardiogenic shock. There are cases where venoarterial ECMO has been used for hemodynamic support after an overdose, however, the use of ECMO as a bridge to extracorporeal removal of the poison has not been widely reported.

Case report: A 33-year-old woman presented from an outside facility after an intentional guarana ingestion. She reportedly ingested 100 grams of guarana powder. The caffeine content was documented as 220 milligrams caffeine per gram of guarana

powder, for an estimated 22 gram caffeine ingestion. She decompensated at the outside facility, requiring intubation and vasopressors for hypotension. She had tachydysrhythmias refractory to 3 attempts of electrical cardioversion and an amiodarone bolus. An esmolol infusion was subsequently started at the recommendation of the Poison Center.
Upon arrival to the receiving facility, the patient had a non-perfusing rhythm and profound hypotension despite infusions of norepinephrine, phenylephrine, and vasopressin. A transesophageal echocardiogram was completed, which showed a markedly decreased ejection fraction consistent with cardiogenic shock. Bedside toxicology consult recommended hemodialysis for removal of caffeine. The interdisciplinary team decided to cannulate the patient for VA ECMO since her hemodynamics were deemed too unstable to tolerate hemodialysis. The patient's perfusion stabilized with ECMO and 4 vasopressors (angiotensin II was added). Renal replacement therapy was initiated. An initial blood flow rate of 200 mL/min which was titrated up to 400 mL/min over the course of the first 4 hours. She received 8 hours of hemodialysis the first day with CRRT overnight and 11.5 hours of hemodialysis on hospital day 2. Following removal of caffeine by these extra-corporeal methods the patient's hemodynamic parameters improved. She was weaned off vasopressors. She was decannulated 4 days into her hospital stay. Her serum caffeine concentration eventually resulted at 425 micrograms/mL. After 10 days in the hospital, the patient was discharged to psychiatric care at her functional baseline.
Discussion: Guarana has the highest concentration of caffeine of any naturally occurring plant and this case demonstrates the extreme toxicity that can be associated with its ingestion. In this case, the definitive treatment for our patient was hemodialysis for removal of caffeine. However, it was thought she was unlikely to tolerate this given her profound cardiogenic shock. The team decided to pursue VA ECMO to augment hemodynamics, as a bridge to extracorporeal removal of the toxin. Ultimately this strategy was effective and allowed for 15.5 hours of hemodialysis in the first 24 hoursTo our knowledge, there is only 1 other case of caffeine toxicity and survival with a serum concentration this elevated.
Conclusions: VA ECMO may have expanded utility in poisoning as a bridge to definitive treatments including extracorporeal removal of toxins. In cases of refractory shock with caffeine, or other poisons amenable to extracorporeal removal, early transfer to an ECMO capable center could be considered.

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135. Isoproterenol and transvenous pacemaker used in lieu of high-dose insulin to successfully treat massive sotalol overdose

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Background: Sotalol is unique among beta-adrenergic antagonists in that it possesses both class II and III antiarrhythmic activity. Sotalol toxicity is characterized by a beta-blocker toxidrome and QT prolongation, the latter of which can lead to Torsades de Pointes. The treatment of sotalol overdose with high dose insulin (HDI) can worsen class III toxicity by lowering serum potassium concentration.
Case report: A 60-year-old man presented to an outside emergency department (ED) after a reported ingestion of 113 sotalol tablets (80 mg/tablet). Initial vital signs were heart rate 38 beats/minute and systolic blood pressure of 146 mmHg. The patient was minimally responsive and seized twice. He had one episode of ventricular tachycardia which resolved spontaneously. He was intubated before transfer to a tertiary hospital with a bedside toxicology service
On arrival at the receiving hospital he was hypotensive with a QTc of >600msec. In light of beta-adrenergic antagonist-induced hypotension, HDI was considered. An ED-based transesophageal echocardiogram showed an ejection fraction of 40%. With acceptable cardiac function,the bedside toxicology team recommended against HDI to avoid hypokalemia potentiating the class III antiarrhythmic toxicity. An isoproterenol infusion was initiated for bridging chronotropic support, and the patient was transferred to the cardiology catheterization suite where a transvenous pacemaker was placed. The patient was admitted to the ICU and hemodynamics improved such that all vasopressors were weaned. A pacemaker was continued until recovery of native electrical conduction on hospital day 6. He was extubated on hospital day 4 and transferred to psychiatry on hospital day 12. Urine chromatography confirmed the presence of sotalol.
Discussion: Sotalol toxicity is difficult to treat given that the class II toxicity from beta-adrenergic antagonism potentiates the toxicity of class III antiarrhythmics. This occurs because at lower heart rates there is a greater risk of Torsade de Pointes. As such in the specific case of sotalol the heart rate itself, in addition to clinical perfusion, becomes important in management decisions. More generally, the decision to treat the beta adrenergic antagonism resulting from sotalol overdose with HDI is complicated by the hypokalemia that may result. Hypokalemia can then exacerbate the class III blockade of sotalol and worsen its toxicity. Given the risk of treatment with HDI and the relatively preserved ejection fraction on echocardiogram the bedside toxicology team decided to preferentially treat the class III blockade with chemical and electrical chronotropic support. This decision ultimately will vary depending on the phenotype of toxicity displayed in each patient and is ideally guided by a bedside clinical toxicology service.
Conclusion: This case highlights a unique treatment plan for severe sotalol toxicity. A mixed antiarrhythmic agent, sotalol presents a unique management quandary as HDI, while typically effective for beta-blocker overdose, may worsen sotalol's class III blockade. In this case bedside TEE was used to guide the decision to pursue overdrive pacing rather than inotropic support with insulin. Clinicians treating sotalol-toxic patients should consider which class of antiarrhythmic toxicity predominates in the poisoning of each patient and tailor their treatment accordingly.

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136. Massive copper sulfate ingestion successfully treated with early aggressive endoscopic decontamination

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Background: Acute copper sulfate ingestion is characterized by multiorgan toxicity including gastrointestinal distress with nausea and vomiting, caustic injury to the esophagus and stomach, methemoglobinemia and hemolysis, hepatic injury, and renal injury. Treatment is generally supportive with antiemetics, pain control, fluids, and infrequent chelation therapy. The role of aggressive early gastrointestinal decontamination and the optimal chelation regimens are not known.

Case report: A 39 year old female presented immediately after ingesting a bottle "Zep Root Kill" along with ethanol and oxycodone in a suicide attempt. The product is purported to contain 99% copper sulfate. On arrival to the Emergency Department, she was noted to have significant oropharyngeal edema and was intubated for airway protection. The estimated amount of ingested product was equivalent to 2.45g/kg of copper sulfate. ED lavage was attempted with little product recovery, and given the immediacy of her presentation after ingestion, the decision was made to pursue endoscopic retrieval of any remaining product. Approximately 1.75 hours after ingestion, endoscopy revealed a thick blue film coating the walls of the stomach. Lesions and erosions were noted within the stomach, but not the esophagus. This product was lavaged directly and suctioned out of the stomach. She was then transferred to a tertiary care center with a bedside toxicology service where she was started on D-penicillamine 500 mg by mouth, three times daily for 5 days. 24 hour urine copper levels on the day after arrival resulted at 1671.9 microgram/24 hours (reference range 3.0-35.0) and 2558.5 microgram/24 hours 3 days after her initial presentation. Serum copper levels were 1.26 microgram/mL (reference range 0.8-1.75 micrograms/mL,) 1.19 microgram/mL, and 1.01 microgram/mL on days one, two, and three of hospitalization. The patient did not develop significant hemolysis, methemoglobinemia, liver, or renal injury. She was extubated on hospital day two, her nasogastric tube was removed on hospital day three, and she was transferred to the medical floor. She was transferred to psychiatry on hospital day four and ultimately discharged to home at her functional baseline seven days after presentation.
Discussion: Copper sulfate ingestion is often fatal, with mortality reported at doses from 0.15-0.3 g/kg. In this case an ingestion reportedly far in excess of that amount was treated with early endoscopic decontamination and oral chelation therapy with D-penicillamine. It is likely that reported early auto-decontamination also limited the amount of toxin absorbed. Urine excretion confirmed the exposure to a large amount of copper but our patient did not develop the expected end organ toxicities associated with copper sulfate ingestion. This case serves an example of the uncertainty around treatment of copper salt ingestions and highlights the role of early, aggressive GI decontamination.
Conclusion: Little is known about the optimal treatment of copper salt ingestions. In this case a large ingestion was successfully treated with early endoscopic decontamination and oral chelation therapy with no end organ toxicity and a return to functional baseline, highlighting the importance of limiting absorption of potentially lethal toxins.

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137. All antihistamines are not the same: a comparison of antimuscarinic effects between hydroxyzine and diphenhydramine poisoned patients

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Background: Antihistamines represent one of the most common poisonings reported to poison centers. In many medical textbooks, poisonings from first-generation H_1 antihistamines, such as hydroxyzine and diphenhydramine, are considered as a group and are generally categorized as having antimuscarinic findings. While many medications in this class have a strong affinity for the human muscarinic receptor, such as diphenhydramine [$K_i = 20 \pm 2$ (nM)], hydroxyzine has a much lower affinity for these receptors [$K_i = 3{,}800 \pm 100$ (nM)]. The objective of this study was to compare the rates of antimuscarinic effects in hydroxyzine and diphenhydramine ingestions. The results of this study may inform providers of a more accurate clinical presentation of hydroxyzine poisoning.
Methods: This was a retrospective, cohort analysis that compared hydroxyzine and diphenhydramine exposures reported to the National Poison Data System (NPDS) from the American Association of Poison Control Centers. The study population included patients older than 13 years with acute, intentional, single-substance ingestions with known outcomes between January 1, 2000, and December 31, 2020. To determine the relative antimuscarinic effects of each medication, we measured the percentage and relative risk (RR) of the following findings: tachycardia, mydriasis, hallucinations/delusions, erythema/flushing, urinary retention, fever/hyperthermia, ileus, and physostigmine administration. To compare overall toxicity, we measured the rate of patients who experienced cardiac arrest, ventricular tachyarrhythmias, major CNS depression, intubation, death, and the NPDS outcome of major effects. We calculated 95% confidence intervals for the RR and compared percentages using Chi-squared testing.
Results: There were 25,629 hydroxyzine and 109,619 diphenhydramine ingestions that met the inclusion criteria. The median ages of hydroxyzine and diphenhydramine exposures were 25 and 24 years old, respectively. A higher percentage of hydroxyzine ingestions were women (72% versus 64%) and reported suicidality (89% versus 80%). Antimuscarinic effects were much more common in patients with diphenhydramine ingestions than hydroxyzine ingestions. Patients with diphenhydramine ingestions also had higher a percentage of severe toxicities including death (0.16% versus 0.02%), major effects (5.2% versus 1.3%), cardiac arrest (0.14% versus 0.01%), ventricular tachyarrhythmias (0.21% versus 0.04%), major CNS depression (1.98% versus 0.55%), and intubation (3.8% versus 0.8%) with p-values <0.01.
Conclusions: This study shows that patients who ingested hydroxyzine have significantly less antimuscarinic effects and severe toxicities than patients who ingested diphenhydramine, a prototypical first-generation H_1 antihistamine. These findings suggest that it is misleading to expect antimuscarinic findings in all first-generation H_1 antihistamines, which is consistent with the pharmacology of hydroxyzine. Furthermore, despite the higher rate of patients with suicidal ingestions, patients with hydroxyzine exposures had lower rates of severe toxicity. This study is limited by the use of observational data collected for clinical care rather than research. However, there is no reason to expect that there were systematic differences in data collection between hydroxyzine and diphenhydramine cases.

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138. Junctional tachycardia and hypertension after oral detomidine exposure

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Background: Exposures to veterinary products are infrequently reported to poison centres. The majority of reported exposures are unintentional and result in minor or no symptoms. We report a patient with an intentional oral exposure to detomidine who developed a decreased level of consciousness (LOC), hypertension and junctional tachycardia.

Case report: A 40-year-old female presented to the emergency department (ED) 90 minutes post intentional ingestion of detomidine. She had a history of depression and hypertension. She reported to a family member that she had ingested four 3 mL detomidine syringes (7.6 mg/mL) for a total of 91.2 mg and ethanol in attempt to commit suicide. On scene her initial GCS was 14 but quickly deteriorated to 7. Her vitals were: HR 65/min; BP 151/108 mmHg; RR 28/min; 99% RA; glucose 6.6 mmol/L. On arrival to the ED she had a decreased LOC with a GCS 9. Vital signs were: HR 59/min; BP 160/100 mmHg. Initial ECG done by EMS was reported as normal sinus rhythm. Labs on arrival: Acetaminophen undetectable; ASA undetectable; Ethanol 39 mmol/L; Osmolar Gap -3.5; Na^{+} 139 mmol/L; K^{+} 3.6 mmol/L, Cl^{-} 103 mmol/L; Bicarbonate 21 mmol/L; Anion Gap 15; Creatinine 70 mmol/L; Urea 4.0 mmol/L; CK 97 U/L; pH 7.42; pCO2 39; Lactate 2.8 mmol/L. She was admitted for observation and received IV fluid therapy and 10 mmol KCl intravenously. Two hours post ingestion her ECG revealed a combination of an ectopic atrial rhythm alternating with junctional tachycardia at a rate of 100/min, with a QTc of 538 msec. Her ECG five hours post ingestion was reported as normal. She remained hypertensive for the first 9 hours post ingestion. Sixteen hours post ingestion she was a GCS 15 and eating. Vitals were: HR 70/min; BP 120/66mmHg. She had no further runs of junctional tachycardia.
Discussion: Detomidine is an α_2-receptor agonist commonly used in veterinary medicine for sedation and analgesia in horses. Typical symptoms of α_2-receptor agonist toxicity include decreased LOC, transient hypertension and tachycardia, followed by hypotension and bradycardia. First, second and third degree heart block have also been reported.
Two previous case reports of human exposure to detomidine are in the setting of unintentional intramuscular (IM) injection of self while trying to sedate horses. Both of these patients developed drowsiness and mild bradycardia, with one patient presenting with mild hypotension. There is one case report of intentional IM injection of detomidine and butorphanol that developed a decreased LOC and hypertension.
To our knowledge this is the first published report of oral exposure to detomidine in humans. Our patient developed the expected decreased level of consciousness associated with α_2-receptor agonist toxicity, but also had sustained hypertension and a brief episode of junctional tachycardia. There was no documented hypotension or bradycardia. To our knowledge this is the first case report of junctional tachycardia after exposure to an α_2-receptor agonist, and the first report of toxicity secondary to oral detomidine exposure.
Conclusion: Oral exposure to detomidine can lead to decreased LOC, hypertension, and junctional tachycardia.

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139. Pre-teen suicide attempts by overdose increase by 24.1% in 2020; the era of COVID-19

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Objective: According to the Center for Disease Control and Prevention (CDC) the number of suicides in the United States (U.S.) has risen by 25% over the last 2 decades. Suicide is the 10th leading cause of death in the U.S. approximately 123 suicides a day. The rates of suicide attempts vary depending on demographic characteristics such as gender, ethnicity, race, and age. Children as young as six years of age have attempted suicide by overdose. There are many reasons why children attempt or commit suicide; Mental illness such as depression, bipolar disorder, borderline personality, eating disorder, feelings of worthlessness, hopelessness, cyber bulling, physical or sexual abuse and environmental stresses like the COVID-19 pandemic. Preteens are impacted by family conflicts and stresses. The purpose of this research is to determine if there has been an increase in preteen suicide attempts by overdosing over the past year during the COVID-19 pandemic.
Method: A retrospective data review of 6 regional Poison Centers in the U.S. documenting suicide attempts by overdose in preteens between 6 and 12 years of age in 2020 and compare results to similar documented cases from the same 6 regional Poison Centers in 2019.
Results: In 2019 PCs under review documented 584 case of preteens attempting suicide by overdose. In 2020, during the covid pandemic, the same PCs under review documented 725 similar cases, a 24.1% increase in suicide attempts by preteens.
Conclusion: According to the CDC suicides in the United States have risen by 25% over the last 2 decades. The retrospective data reviewed from the 6-Poison Center in 2020, yield an alarming 24.1% increase in suicide attempts by children between the age of 6 to 12 years of age in one year; the year of the COVID-19 pandemic.

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140. Teen suicide by drug overdose has increased over the last decade

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Objective: The Center for Disease Control and Prevention (CDC) has documented an increase rate in suicides among American youth over the last decade making suicide the second leading cause of death among teens. According to the CDC director Robert Redfield, suicide has claimed more young lives than covid-19 during the pandemic. The public health institute reported that the suicide rate for children between 10 to 14 has almost tripled over the last decade and the suicide rate in older teens has increased by 76%. According to the national Institute of Mental Health the top 3 methods to commit suicide in order of greater frequency is by firearms, suffocation, and poisoning. The objective of this data review is to compare the CDC's findings on drug related deaths among American youth and the findings of 11% of the Poison Centers overdose fatalities between the ages of 12 to 19 years old over the last decade.
Methods: A multi-center retrospective data review on individuals ages 12-19 who commit suicide by overdose. Data on youth suicide by overdose from 11% of regional Poison Centers in the U.S. will be summed up and the findings compared to the CDC's finding to determine if the PCs have documented an increase in youth suicide by overdose.
Results: The findings from 2011 to 2020 documented a total of 37 teens who committed suicide by overdose. In 2014 a 15 y/o committed suicide by taking an overdose, 3 teens committed suicide by overdose in 2016, 4 in 2017, 7 in 2018, 13 in 2019 and 10 teens committed suicide by taking an overdose in 2020.
Conclusions: In the retrospective data reviewed from 11% of the Poison Centers in the U.S. 37 youths committed suicide by taking a drug overdose between 2001 and 2020. Youth suicide by drug overdose has steadily risen over the last decade.

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141. Risk factors of serious adverse events in benzodiazepines exposures reported to the US poison centers

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Background: In 2019, there were approximately 92 million benzodiazepines prescriptions dispensed from U.S. outpatient pharmacies. Benzodiazepines are one of the most commonly misused illicit or prescription substance in the U.S. Drug overdose deaths involving benzodiazepines rose from 1,135 in 1999 to 11,537 in 2017. Approximately 30% of overdoses involving opioids also involve benzodiazepines. The objective of the study was to highlight the risk markers of serious adverse events involving benzodiazepines exposures using a national poison center (PC) database.
Methods: The National Poison Data System (NPDS) was queried for exposures to benzodiazepines from 2010 to 2019 using generic code identifiers. We descriptively assessed the relevant demographic and clinical characteristics. Cases with severe adverse events (SAEs) were defined as exposures that resulted in either a death or major clinical outcomes. Independent predictors of SAEs were studied using logistic regression. Adjusted odds ratios (AOR) and the corresponding 95% confidence intervals (95% CI) were reported.
Results: There were 732,863 human exposures to benzodiazepines reported to the PCs during the study period. Of these, 45,543 cases (6.2%) demonstrated SAEs, with the frequency of such exposures increasing by 32.1% during this period (4,262 to 5,632, $p < 0.001$). Polysubstance exposures accounted for 63.1% of benzodiazepines exposures and were more common in exposures resulting in SAEs (91% vs 62.3%). Approximately 76.1% of the patients reporting benzodiazepines exposures with SAEs were admitted to the critical care unit (CCU), while 6.1% patients were treated and released. Residence was the most common site of exposure (91.4%), and 94.4% cases were en-route to the hospital when the PC was notified. Among the patients with SAEs, 60.3% were females, with the majority of benzodiazepines exposures occurring between the ages of 40-49 years (22.1%). Suspected suicides (74.7%) was the most commonly reported reason for exposure. The risk of SAEs was the highest in cases between 50 and 59 years of age (Ref: 20 – 29 years) (AOR: 1.68, 95% CI: 1.63 – 1.74). Conversely, cases under 19 years of age (AOR: 0.67, 95% CI: 0.65 – 0.70) were 33% less likely to have a SAE. Males were 15% more likely than females to have a fatal overdose (AOR: 1.15, 95% CI: 1.13 – 1.17). Poly-substance exposures significantly increased the risk of SAE, with the odds increasing 4-fold in exposures involving multiple opioids. Other Important predictors of an opioid-related death were intentional abuse (Ref: Unintentional exposure) (AOR: 2.02, 95% CI: 1.93 – 2.11), parenteral route of administration (Ref: Ingestion) (AOR: 3.68, 95% CI: 3.40 – 4.23) and co-occurring alcohol exposures (Ref: No Alcohol Exposure) (AOR: 1.28, 95% CI: 1.24 – 1.31).
Conclusions: Significant risk factors of benzodiazepines exposures resulting in SAE included increasing age, gender, specific exposure reasons and exposure to other substances. Abuse and diversion of benzodiazepines may be as a result of its perception as a low cost alternative to opioids. Benzodiazepines has also been increasingly associated with suicidal ideation, the most common reason for exposure in our sample. Increasing prescriber awareness and improved screening prior to prescribing may be key to reduce such overdoses.

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142. Mixed opioid, sympathetic, and serotonergic toxidrome in the setting of extended-release tapentadol ingestion

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Background: Tapentadol is a central μ-opioid agonist analgesic that also inhibits norepinephrine and serotonin reuptake. We present a case of unwitnessed, reported intentional ingestion of 750mg of another household member's extended-release (ER) tapentadol, in a 15-year-old female with a history of major depressive disorder and two past suicide attempts by way of ingestion.
Case report: The patient's mother noticed altered mental status (AMS) and ataxia 19 hours after reported ingestion time, which were preceded by somnolence and nausea for an uncertain amount of time. She presented to our ED 21 hours after reported ingestion with ataxia, fatigue, (AMS), nausea, hypertension, tachycardia, hyperreflexia, opsoclonus, and miosis. Hypertension and tachycardia peaked at 20.25 hours after reported ingestion. There was no extremity clonus. Acetaminophen, ethanol, and salicylate serum levels were negative. An Abbott Alinity immunoassay urine test was positive for methadone. Her mother denied the presence of methadone or narcotics apart from tapentadol at home. An EKG showed normal QT and QRS. She was stable from a respiratory and hemodynamic standpoint, and was subsequently admitted for close monitoring with toxicology consultation. After admission, she developed bradypnea (without a clear peak) at 25.25 hours after reported ingestion. But her respiratory status remained stable and did not require naloxone administration. She continued to have tachycardia, hypertension, and AMS but did not require intervention. The urine sample from the Abbott Alinity immunoassay test was sent for Roche immunoassay testing, which resulted negative for methadone and EDDP. This suggested that the Abbott immunoassay's result was likely due to cross-reaction with tapentadol. Her tachycardia and hypertension resolved by 29.75 hours. Her bradypnea and AMS resolved 33.25 hours after reported ingestion. A tapentadol blood test was not available. A repeat EKG had normal QT and QRS. She was then medically cleared and transferred to an inpatient psychiatric facility. Subsequent experimentation involving spiking blank urine with 100,000ng/mL of tapentadol, resulted in negative numbers with Roche methadone immunoassay testing.
Discussion: Tapentadol is available in an ER formulation for patients with chronic pain and diabetic peripheral neuropathy. A retrospective study of tapentadol overdose reported mostly opioid-like toxicity. Toxic effects reported in an NPDS study included nausea, vomiting, dyspnea, pallor, tachycardia, respiratory depression, dizziness/vertigo, miosis, slurred speech, coma, urticaria, pruritus, and hallucinations/delusions. Fifty-three of the 104 patients were reported to have had no medical intervention. At therapeutic dosing (100-250mg every 12 hours), ER tapentadol's serum concentration peaks in 5 hours and has a mean termination half-life of 4.4-5.9 hours. Overdose can cause a mixed opioid, sympathetic, and serotonergic toxidrome.
Conclusions: This patient presented with a mixed opioid, sympathetic, and serotonergic toxidrome, attributed to her reported ingestion of 750mg of ER tapentadol 21 hours earlier. The timeframe of her signs/symptoms shows that overdose of ER tapentadol can lengthen the time to peak effect and elimination half-

life. Additionally, this case and subsequent experimentation indicates that the Roche immunoassay avoids false positive results for methadone in cases of tapentadol ingestion.

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143. Effects of physostigmine on antimuscarinic delirium captured on EEG

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Background: Antimuscarinic poisoning leads to a wide range of alterations in mental status from hypoactive delirium to agitation and hallucinations. We present a case of a 15-year-old woman presenting in a stupor following an amitriptyline overdose in whom the administration of physostigmine was captured on electroencephalogram (EEG).
Case report: The patient is a 15-year-old female with a history of supraventricular tachycardia (on propranolol), cyclic vomiting syndrome, migraines (on amitriptyline), and depression (on sertraline) who presented to the Emergency Department (ED) with altered mental status after being found unresponsive in the middle of the night. Per family, she had discontinued her amitriptyline and sertraline months prior.
Her initial exam was notable for flushing, mild tachycardia, mydriasis, dry mucous membranes, and anhidrosis. She would mumble incomprehensibly and withdraw to pain but would not follow commands, open her eyes, or regard examiners.
Her initial work up was notable for a normal head CT and a urine drug screen that was positive for tricyclic antidepressants. The patient had not endorsed any suicidal ideation to her family and had no history of self-harm. Given concern for subclinical seizures, neurology was consulted and a stat EEG was initiated in the ED, with plans for subsequent brain MRI and lumbar puncture.
Shortly after initiating EEG, the patient's father called to report that he had found an empty bottle of amitriptyline at home and the toxicology service was consulted. Toxicology recommended to administer one milligram of intravenous physostigmine as a diagnostic test for antimuscarinic delirium.
Discussion: Five to ten minutes after administration of physostigmine the patient awoke, started to answer questions, and follow commands. Electrographically, EEG background at the beginning of the recording was consistent with stage II sleep with presence of vertex waves and sleep spindles. Excessive generalized theta frequency for age was consistent with mild encephalopathy. Slowing of EEG background improved after physostigmine administration and normal awake EEG background features, including alpha rhythm, appeared. Given confirmation of a diagnosis of antimuscarinic delirium, further diagnostic studies including MRI and lumbar puncture were cancelled and the patient was admitted for further monitoring.
Conclusion: The reversal of antimuscarinic delirium with physostigmine resulted in clinical improvement in mental status and transition of EEG background from sleep to awake with resolution of mild generalized slowing. To our knowledge, this is the first time that the effect of physostigmine on antimuscarinic delirium was captured on EEG.

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144. Delayed physostigmine administration for anticholinergic delirium after confirmed acute amitriptyline overdose

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Background: The use of physostigmine for tricyclic antidepressant-induced antimuscarinic toxicity is controversial, as case reports suggest a lethal interaction. We present a case in which a patient with anticholinergic delirium was successfully treated with physostigmine without complication.
Case report: A 17-year-old 81kg man intentionally overdosed on an unknown amount of amitriptyline and was found unresponsive with flexor posturing. He presented to a community hospital where he was intubated due to altered mental status. His initial ECG showed a QRS duration of 118msec, therefore 100 mEq of sodium bicarbonate was administered. This was followed by a sodium bicarbonate infusion (1L dextrose 5% in water with 150mEq of sodium bicarbonate), as well as fentanyl and midazolam infusions for sedation, and he was transferred for further care. A subsequent ECG showed widening of the QRS interval to 132 msec. He was continued on the sodium bicarbonate infusion, 50g of activated charcoal was administered, and after a self-limited episode of hypotension, he was transferred to a tertiary care facility for potential extracorporeal membrane oxygenation (ECMO) for hemodynamic support. Upon arrival (24 hours after initial presentation) he was tachycardic (132 bpm) and his examination was notable for dry skin, flushed appearance, mydriasis, absent bowel sounds, hyperreflexia, clonus (7-8 beats), and frequent myoclonic jerks. His ECG was notable for sinus tachycardia (132bpm) and a QRS duration of 80msec in the limb leads. His electroencephalogram (EEG) showed moderate generalized slowing without evidence of seizure activity. Sodium bicarbonate infusion was discontinued and his QRS remained narrow for >24 hours. His sedation was weaned but he remained unresponsive with mydriasis and clonus. Physostigmine (0.5mg) was administered over 5 minutes and he was observed for 10 minutes without notable change in vital signs or examination. An additional 1mg was administered and the patient began to follow intermittent commands and lacrimation was noted. Due to attempts to self-extubate, he was sedated with boluses of propofol and an additional 0.5mg of physostigmine was administered. Shortly thereafter he was extubated. Lorazepam (1mg) was given for anxiolysis. More than 80 hours after his overdose, his serum concentrations of amitriptyline and nortriptyline were 682 ng/mL and 437 ng/mL, respectively. His hypotension never recurred, and he was ultimately discharged to an outpatient psychiatric facility without neurologic deficit.
Discussion: Several considerations were made prior to the use of physostigmine in this case. The patient had no bradycardia, he received sodium bicarbonate with appropriate narrowing of his QRS, it had been >48 hours since his ingestion, and his ECG showed narrow complex tachycardia immediately prior to treatment. He was under constant monitoring with video EEG that showed no seizure activity. Peripheral and central antimuscarinic effects remained evident. Thus, the overall risk of bradycardia, asystole, and seizure was outweighed by the potential benefit of

improving the patient's mental status and reducing his intubation time and ICU stay.
Conclusions: This case demonstrates a safe and efficacious use of physostigmine to treat anticholinergic delirium due to amitriptyline overdose after treatment and resolution of cardiotoxic effects of sodium channel blockade.

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145. Profound CNS depression mimicking brain death and metabolic acidosis following intentional gabapentin and ibuprofen overdose

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Background: Gabapentin is an anticonvulsant that inhibits presynaptic N-type Ca channels. Acute overdoses are generally well tolerated and require only supportive care. Somnolence, ataxia, and slurred speech are reported. Although dialyzable, this is rarely indicated. Ibuprofen is a non-steroidal anti-inflammatory drug (NSAID) which competitively inhibits cyclooxygenase. In overdose, it can cause acute kidney injury, metabolic acidosis, and central nervous system (CNS) depression, but generally responds well to supportive care. Due to its high protein binding, ibuprofen is not readily dialyzable. Certain xenobiotics (e.g. baclofen, bupropion) are reported to cause profound CNS depression accompanying a loss of brain stem reflexes. This has led to the term "brain death mimic," which to our knowledge has not been reported with ibuprofen or gabapentin.
Case report: This is a single patient case report. A 15-year-old previously healthy female was found unresponsive, apneic, and pulseless by parents next to empty bottles of gabapentin and an unlabeled bottle thought to have contained ibuprofen. Cardiopulmonary resuscitation was initiated by the patient's mother and EMS with return of spontaneous circulation. She was given naloxone twice without change in mental status and intubated for airway protection without medications. She had a GCS of 3, core temperature of 32 C, and was hypotensive requiring hemodynamic support with norepinephrine and epinephrine. She was transferred to a tertiary pediatric intensive care unit. On exam she was unresponsive with dilated, nonreactive pupils, and absent brainstem reflexes. Labs were notable for a creatinine of 1.97 mg/dL, bicarbonate 7 mmol/L, and an anion gap of 29, with an arterial pH of 6.92 and lactic of 14.1 mmol/L. Additional findings included elevated creatine kinase, peaking at 11,167 U/L. CT brain, ECG, and EEG were unremarkable.
The patient had refractory metabolic acidosis with sodium bicarbonate therapy, and CRRT was initiated. On hospital day 1 the patient began to improve, responding to commands. She was extubated on hospital day 4, CRRT was stopped on day 5, and the patient returned to her neurologic baseline and normal renal function. A brain MRI was subsequently unremarkable. Initial gabapentin concentration was 57.9 mcg/mL (therapeutic maximum is 8.5 mcg/dL) and ibuprofen concentration was "greater than 360.0 mg/L" (exact concentration not determined by reference laboratory).
Discussion: CNS depression has been reported following overdose with either gabapentin or ibuprofen; however, coma with loss of brainstem reflexes is rarely reported. This patient had loss of multiple cranial nerve reflexes and apnea requiring ventilator support with no response to noxious stimuli. This is consistent with the examinations of previously reported brain death mimics, including baclofen, bupropion, GHB, and barbiturate overdoses. The effect of CRRT on elimination of gabapentin in this case cannot be determined because the dialysate was not analyzed. Given the extensive protein binding of ibuprofen, it is unlikely dialysis had any effect on its elimination.
Conclusion: We report a case of gabapentin and ibuprofen overdose leading to profound CNS depression, mimicking brain death, and metabolic acidosis requiring hemodialysis with a full neurological recovery.

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146. Systemic toxicity from subcutaneous brimonidine injection successfully treated with naloxone

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Background: Brimonidine is a topical ophthalmic alpha-adrenergic agonist solution indicated for lowering intraocular pressure in patients with open-angle glaucoma or ocular hypertension. Although uncommon, there are reports of drowsiness, lethargy, hypotension, bradycardia, and respiratory depression in infants after ingestion. We report a case of subcutaneous injection of brimonidine in an elderly patient resulting in hypotension, lethargy, and bradycardia that responded to naloxone.
Case report: A 73- year- old female with a past medical history of diabetes, hypertension, hyperlipidemia, myasthenia gravis, glaucoma, and cardiac arrest status-post indwelling pacemaker presented to the emergency department after injecting her brimonidine tartrate ophthalmic solution subcutaneously (SQ). The patient initially disclosed it was a mistake and she thought it was her insulin. Family disclosed that the patient had been having suicidal thoughts after her husband passed away and had been injecting brimonidine into her forearm intentionally. Although she was diagnosed with hypertension, the patient was not taking any antihypertensive medications or opioids. Initial presentation consisted of lethargy, a paced rhythm of 60 bpm, and blood pressure of 91/24 mmHg with a MAP of 46. Due to CNS depression, 3 mg of intranasal naloxone was administered. The patient then received intravenous fluids and was treated with a total of 12 mg IV naloxone boluses and an infusion at 2 mg/hr. Mental status subsequently improved, blood pressure increased to 114/65 and HR remained paced at 60. Laboratory studies were reported as normal except for a glucose of 416. Venous blood gas revealed a pH of 7.40 and pCO2 36.4. The patient was admitted to the ICU and naloxone was subsequently weaned over 12 hours.
Discussion: Clonidine and other central alpha agonist medications are well-known to result in sympatholytic effects including CNS depression, bradycardia, hypotension and may mimic the opioid toxidrome. Brimonidine injection has not previously been reported and this case has similar findings to other central alpha agonist poisonings. Naloxone has previously shown variable reversal of CNS depression in central alpha-2 overdose and may require higher doses. While systemic brimonidine toxicity is rare, naloxone may be a useful adjunct treatment in severe cases.
Conclusion: Systemic central alpha-2 agonist toxicity resulted from SQ brimonidine injection, a topical ophthalmic preparation. High-dose naloxone was useful for reversing CNS depression.

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147. Vasopressor requirements in antipsychotic overdose, a poison center observational study

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Background: In addition to antagonizing the D2 receptor, the antipsychotic class has variable degrees of peripheral alpha antagonism. Blockade of the peripheral alpha one receptor causes vasodilation and can lead to hypotension. Initial treatment of hypotension includes crystalloid boluses, but refractory hypotension may require vasopressors such as norepinephrine or phenylephrine. The primary aim of this study was to evaluate the occurrence of hypotension after antipsychotic overdose and characterize vasopressor administration.
Methods: This was a retrospective cohort study conducted by chart review of electronic records from two regional poison centers from January 1, 2004 to December 31, 2020. Inclusion criteria were single acute antipsychotic exposures evaluated in a health care facility, age >14, and if hypotension or vasopressor was coded. Exclusion criteria included missing data, minor or no effect outcomes and polypharmacy overdose. The primary outcome was hypotension which was defined as systolic blood pressure <90 mmHg and/or MAP <65. Analysis was performed using SAS software.
Results: During this study period, there were 1852 single acute antipsychotic overdoses. After exclusions there were 392 cases with moderate or severe outcomes. The mean age was 42 (SD =16) and 70% were female. There were 169 cases with hypotension. There were no deaths and no patients required cardiopulmonary resuscitation. Hypotensive patients were treated in the ICU (n = 115, 69%), floor (n = 24, 14%), or either admitted to psychiatry or discharged from the ED (n = 27, 16%). Of the hypotensive cases, 92% involved atypical antipsychotics, with quetiapine being most common (n = 128, 76%). Vasopressor therapy was administered in 16/169 cases (9.9%). In the cases where vasopressor use was recorded, norepinephrine was used 12 times, dopamine 3 times, and phenylephrine once. One patient received both norepinephrine and phenylephrine.
Conclusions: Overall, we found that hypotension following single acute antipsychotic overdose is uncommon and vasopressors are rarely required. Quetiapine appears to be the most common antipsychotic agent associated with hypotension following overdose.

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148. Increase in emergency department visits for overdose and intoxication during the COVID-19 pandemic

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Background: Overdose deaths and emergency department (ED) visits for overdose and mental health concerns have increased during the COVID-19 pandemic. The purpose of this study is to describe trends in overdose and intoxication presentations to a single ED during the fourteen months preceding and following March 2020, when COVID-19 case activity appeared in the surrounding community.
Methods: This retrospective cohort study setting is the ED in a large academic quaternary medical center with approximately 80,000 visits annually, of which about 30% of patients are admitted. The electronic medical record was queried for patients with an ED diagnosis of overdose or poisoning between January 1, 2019 through April 30, 2021. ICD-10 codes for the ED encounter associated with intentional ingestions among T30 to T50 and F10 to F19 were included. Patients were excluded if age less than 10 years, accidental or unintentional poisoning, or food poisoning. Encounters from January 1, 2019 through February 29, 2020 were considered "pre-COVID" while encounters from March 1, 2020 to April 30, 2021 were considered "during COVID." The primary endpoint was to compare the proportion of ED encounters for overdose or intoxication during COVID vs pre-COVID. Secondary endpoints included comparing the proportion of patients presenting with suicidality (as indicated by ICD-10 codes), death as a result of the index visit, and disposition (discharge vs admit).
Results: Overall, ED visits decreased by 17.8% while visits related to intoxication or overdose increased by 14.4% (476/74,512 vs 416/90,616, $p < 0.00001$) during COVID compared to pre-COVID. This reflects a 39% increase in ED encounters for intoxication or overdose as a proportion of total ED visits during COVID. Total pediatric ED visits decreased by 34.8% while the number of pediatric ED visits related to intoxication or overdose increased by 11.3% (89/10,212 vs 80/15,654, $p < 0.0004$). This reflects a 70.5% increase in pediatric ED overdose or intoxication encounters, as a proportion of total pediatric ED visits during COVID. The increase in all overdoses initially spiked in August 2020, 5 months after the appearance of COVID-19 in our region. The distribution of patient demographics remained the same during COVID [age(-years): 31 +/- 15.7 vs 32 +/- 16.7; sex (female): 252 (52.9%) vs 211 (51%); proportion uninsured: 32 (7.7%) vs 33 (7.9%)]. There was also no change in the overall proportion of patients presenting with suicidality [164/476 (34.7%) vs 163/416 (39.7%), p = NS]; the proportion of patients admitted to hospital from the ED [327/476 (68.7%) vs 305/416 (73.3%), p = NS]; nor in the number of deaths during hospital admission [4/476 (0.84%) vs 7/416 (1.68%), p = NS].
Conclusions: Although the total number of ED visits decreased during COVID, the number and proportion of visits related to intoxication or overdose significantly increased during the pandemic. This was particularly notable for pediatric patients. There were, however, no difference in demographics of overdoses, nor in the rate of admissions or death. Our data suggest that, in our population, although the proportion of ingestion cases presenting to the ED increased during COVID, the severity of cases may not have.

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149. Intentional overdose with hydroxychloroquine and diphenhydramine, with corresponding serial levels of hydroxychloroquine and serial ECG

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Background: The cardiotoxic effects of hydroxychloroquine include cardiac conduction abnormalities such as QRS and QT

prolongation due to sodium and potassium channel blockade. We report a case of a 42-year-old male who presented with a self-harm ingestion of hydroxychloroquine and diphenhydramine and developed QRS and QT prolongation and had correlating elevated hydroxychloroquine levels.

Case report: A 42-year-old male with a previous history of post-traumatic stress disorder and depression not on any medications presents after ingestion of 30 tablets of hydroxychloroquine 200 mg and 10 tablets of diphenhydramine 25 mg one hour prior to arrival to the Emergency Department. On presentation, he was awake and alert with vital signs: BP: 87/55 mmHg, HR: 91 bpm, RR: 16/minute, and Oxygen saturation 98% on room air. Initial ECG showed: normal sinus rhythm (NSR):89, QRS:142, and QTc:592. There was no previous ECG for comparison. He was given 50 grams of activated charcoal and an intravenous bolus of 200 meq sodium bicarbonate. Repeat ECG after sodium bicarbonate showed NSR 79, QRS 132, and QTc 593. A sodium bicarbonate drip was initiated. The patient was then intubated, administered a bolus of diazepam 2 mg/kg, and initiated on an epinephrine infusion. His blood pressure and heart rate after treatment was BP 110/81 mmHG and HR 90 bpm. Repeat ECG was NSR 91 QRS 132 QTc 581. Laboratory values were normal except for potassium =2.8 mmol/L. The patient was admitted to the ICU. On hospital day(HD) #1, his bicarbonate drip was discontinued because of his elevated pH level and low potassium. His blood pressure was maintained above a MAP of 65. On HD #2 repeat ECG showed NSR 83 with QRS 122 and QTc 505. On HD#3, ECG showed NSR 82 with QRS 120 and QTc 490. He was extubated on HD#3 and subsequently medically cleared. Hydroxychloroquine level measured using liquid chromatography-tandem mass spectrometry on HD #1 was 7400 ng/ml and on HD#2 was 4600 ng/ml.

Discussion: Calls regarding hydroxychloroquine have increased to poison control centers since it has been purported as treatment and prophylaxis for coronavirus disease 2019 (Covid-19) though studies have not supported its efficacy for this disease. We report the case of an intentional overdose of hydroxychloroquine and diphenhydramine with serial hydroxychloroquine levels and association with widened QRS and QTc on serial ECG. This is likely due to the synergistic sodium channel blockade of diphenhydramine and hydroxychloroquine. The increased QRS and QTc duration was associated with elevated hydroxychloroquine levels.

Conclusion: Caution should be used when prescribing hydroxychloroquine given risk of cardiac toxicity in overdose and use with other drugs that have sodium channel blockade effects.

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150. Increasing rates of intentional poisoning by pharmaceuticals among children and teens during the COVID-19 pandemic: a retrospective review of statewide submissions to the National Poison Data System

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Background: SARS-COV-2 wreaked havoc on the world in 2020, causing significant death, widespread illness, loss of employment, forced social isolation, and heightened stress and anxiety among people of all walks of life. There has been much speculation regarding the indirect consequences of the lockdown, such as potentially increased rates of suicide or drug abuse as a result of a buildup of psychological stress and anxiety. The purpose of this study was to investigate the trend of intentional pharmaceutical drug poisonings using National Poison Data System (NPDS) data reported to the poison center network in a single state from 2016 – 2020, particularly to evaluate for a change in trend from 2019-2020 during the COVID-19 pandemic.

Methods: A retrospective comparative analysis of the number of cases of intentional pharmaceutical drug poisonings in various age groups reported to NPDS in our state for each year was conducted, and the rate for each year was calculated using population estimates from our state's Demographic Center to control for population growth. The inclusion criteria were exposure to a single or multiple pharmaceutical drugs. Reasons for call were limited to intentional drug abuse, misuse, or suicide attempt. Exclusion criteria included any records where the intentionality of the poisoning was unknown and records where the exact age of the patient was not documented.

Results: The number of reported cases of intentional pharmaceutical drug poisonings reported to NPDS by our state's poison center network declined by 4.46% in 2020 as compared to 2019, reversing a pattern of steady increases of 2.33% on average annually over the prior 3 years from 2016-2019. All adult age groups in this study exhibited a similar pattern. However, the number of annually reported cases of intentional drug poisonings in children and teenagers has been increasing every year including 2020, leading to an increase of 54.8% in children ages 6-12 years, and 20.7% in teenagers ages 13-19 years over this 5-year period.

Conclusions: There are two important implications from the findings in this study. The first is that the COVID-19 pandemic did not lead to an increased rate of intentional pharmaceutical drug exposures in adults; in fact, it appears to have led to a paradoxical decrease. There are many potential factors that may have contributed to this decrease, and one possible explanation is a significant decrease in the number of hospital visits, consequently leading to comparatively decreased rates of prescription filling. The second and perhaps more critical discovery from this project is that even during a pandemic with significantly decreased hospital visits, the rate of intentional pharmaceutical drug poisonings among children and teenagers continued to increase rapidly. This highly concerning pattern needs to be addressed by future studies, which can hopefully help bring about impactful changes in healthcare management, legislation, and public health measures to end this crisis.

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151. Attempted suicide with concomitant ocular exposure during COVID: an analysis of statewide data reported to the National Poison Data System

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Background: Predictive modeling utilizing the World Bank Open Data and International Labour Organization press releases demonstrated a foreseeable increase in suicides ranging from 2135 to 9570 per year during the COVID pandemic.[1] According to WHO, each confirmed suicide in any given population is associated with more than 20 suicide attempts.[1] Recent systematic reviews

regarding the association between suicide rates and international respiratory outbreaks, such as COVID-19, have resulted in recommendations to increase international mental health awareness.[2] Exposure to ocular toxicants can lead to decreases in visual acuity & irreversible blindness, which has been linked to a non-significant increase in risk of suicide.[3] Our study evaluates cases of attempted suicide with concomitant ocular exposure during the pandemic using information reported to the National Poison Data System (NPDS) by a statewide poison center network.

Methods: This retrospective cohort analysis of data reported to the National Poison Data System allowed for comparison of cases of attempted suicide with concomitant ocular toxicant exposure during the United States COVID pandemic as compared to the prior 5 years by utilizing de-identified human ocular exposure calls to the poison center network in a single state. Included dates during the pandemic ranged from January 1, 2020 to December 31, 2020. Comparative cases ranged from January 1, 2015 to December 31, 2019, a 5-year time frame.

Results: A total of 41 patients met inclusion criteria during the COVID pandemic within our state, in contrast to a total of 25 cases in the preceding 5-year time window between 2015 and 2019. There were a total of 3 cases in 2015, 8 cases in 2016, 4 cases in 2017, 4 cases in 2018, and 6 cases in 2019. This represents a 64% increase in number of cases during COVID as compared to the entirety of the prior 5 years. Demographics during the pandemic were stratified by those aged 6-12 years (N = 3), 13-19 years (N = 15), 20-29 years (N = 6), 30-39 years (N = 5), 40-49 years (N = 4), and 50-59 years (N = 7). This represents an increase in cases in teenagers and adults aged 20-29 years by 66% and 100%, respectively. Most common substances listed as the culprit for ocular exposure during COVID are ethanol (beverage) (N = 4), bleaching agents (N = 3), lacrimators (capsicum) (N = 3), and gasoline (N = 2), amongst others. In both cohorts, ocular irritation/pain, red eye/conjunctivitis, and drowsiness/lethargy were listed as the top 3 clinical symptoms reported to the NPDS during case evaluation.

Conclusions: The COVID pandemic in 2020 coincided with drastically increased frequency of attempted suicide with concomitant ocular exposure as compared to the prior 5 years. Age groups with increased susceptibility were teenagers as well as young adults between the ages of 20-29 years. Ethanol, bleaching agents, lacrimators (capsicum), and gasoline were the top culprits of ocular exposure during reported cases of attempted suicide. Accidental eye injury associated with unsuccessful suicide attempt could lead to lasting morbidity, further decreasing quality of life for depressed individuals and increasing risk of future suicide attempts. Thankfully, ocular symptoms were generally mild in this cohort.

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152. Severe acute metformin associated lactic acidosis treated with hemodialysis: a case series of two pediatric patients

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Background: Metformin, a biguanide, is a first-line medication to treat type 2 diabetes mellitus. An uncommon but serious adverse effect of therapeutic administration is lactic acidosis due to bioaccumulation, typically in the setting of renal insufficiency. Acute overdose has rarely been reported to cause a lactic acidosis in otherwise health patients. We report two pediatric cases of massive metformin overdoses that developed severe lactic acidosis and improved with intermittent hemodialysis (IHD): one resulted in a multiorgan system failure and death.

Case series: Case 1: A 16-year-old male with a history of schizophrenia presented to a community hospital following a suicidal ingestion of approximately 20g of metformin and a bottle of vodka. On presentation, the patient was obtunded and developed a PEA cardiac arrest. Post-ROSC labs showed pH 6.8, lactate 19 mmol/L, ethanol 71 mg/dL, and creatinine 2.2 mg/dL. A bicarbonate infusion was started, and the patient was transferred to a regional pediatric hospital for dialysis. On presentation to the pediatric hospital vitals were heart rate 123 bpm and blood pressure 98/43 mmHg on norepinephrine, epinephrine, and vasopressin. Repeat labs were pH 6.71, Lactate 28 mmol/L, INR 1.69, Metformin 470 mcg/ml. Intermittent HD was started and pH improved to 7.0. After 4 hours of IHD the patient was transitioned to continuous renal replacement therapy (CRRT). Blood pressure worsened despite increasing vasopressor support and the patient sustained a PEA arrest. The patient was placed on 4 vessel ECMO. Subsequent lactate was 29.5 mmol/L and pH 6.3-6.5. The patient developed DIC, multiorgan failure, and subsequently expired.

Case 2: A 16-year-old male with a history of depression presented to a community hospital following a suicidal ingestion of two handfuls of 1000 mg metformin tablets. He presented with abdominal pain and myalgias but subsequently became somnolent. Initial lactate was 4.2 mmol/L and increased to 17 mmol/L prior to transfer to a regional pediatric hospital. On presentation to the pediatric hospital initial labs were pH 6.86, Lactate 19.7 mmol/L, WBC 42.6 TH/uL, potassium 5.8 mmol/L, bicarbonate <5 mmol/L, creatinine 2.12 mg/dL. Within an hour lactate worsened to 26.6 mmol/L. The patient was started on IHD for 6 hours with improved lactic acidosis. He was transitioned to CRRT for two days with clearance of the lactic acidosis after one day. The patient has since fully recovered. Serial metformin levels are pending.

Discussion: Metformin is generally considered a safe medication even in mild overdose; however, in massive overdose it can cause a severe lactic acidosis with hemodynamic instability and multiorgan system failure. The first patient initially improved with IHD but subsequently decompensated after transition to CRRT likely secondary to decreased metformin clearance and worsening acidosis. The second patient, treated at the same tertiary pediatric hospital, likely benefited from a longer IHD and plan for additional IDH if he decompensated on CRRT.

Conclusion: Acute, large metformin ingestions can lead to a severe lactic acidosis and multiorgan system failure. Clinicians should consider that patients may quickly decompensate and may require a longer IHD for metformin and lactic acidosis clearance.

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153. Barriers to obtaining quantitative serum concentrations of toxic alcohols for clinical decision-making

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Background: Toxic alcohols such as ethylene glycol and methanol can cause profound metabolic acidosis, permanent end organ injury, and death. Definitive toxic alcohol testing is unavailable in many areas and makes clinical decision making difficult or leads to unnecessary hospitalization in treatment. For instance, toxic alcohol testing is available from a single laboratory in the

state where this study was performed. We reviewed poison center data to investigate potential barriers to obtaining quantitative toxic alcohol results early enough to prevent unnecessary treatment.

Methods: Records from a poison center serving a single state were used from December 2016 to December 2019. Toxicall records were identified by searching for cases that received the antidote fomepizole. The hospital system, time of day, reason for exposure, suspected toxic alcohol, age, gender, and the proximity of the healthcare facility to a testing facility were hypothesized to be possible factors contributing to delays in obtaining toxic alcohol results. Timestamped notes entered by specialists in poison information in cases of suspected toxic alcohol exposures were reviewed to determine the timeline regarding toxic alcohol test ordering, results, and fomepizole administration. Outcomes considered included 1) whether or not results were available in time to inform need for a 2nd dose of fomepizole (e.g. within 12 hours of initial dose) and 2) length of time from lab ordering to when results were obtained (outcomes were analyzed via chi-square and single factor ANOVA; respectively).

Results: Of the 125 cases identified, 96 cases were included in the analysis. Cases with incomplete data regarding outcomes or factors measured were excluded from analysis *(n = 29)*. In 15 of the 96 cases analyzed, results were not yet available 12 hours after the initial fomepizole dose. Median age was 36 years old (range 1-82). Ethylene glycol and methanol comprised the majority of the suspected toxic alcohols for which testing was ordered *(n = 66)*. Suspected suicide was the primary reason for exposure *(n = 61)*. Mean, median, and range for driving time from reference lab were 50.7 minutes, 33 minutes, and 6 to 296 minutes, respectively. Only proximity to testing by Chi-squared was significant.

Conclusion: All factors measured failed to demonstrate statistically significant results. However, proximity to a testing facility *(p = 0.058)* approached statistical significance. These results indicate that delays in testing are likely multifactorial and case specific. This study was limited by the ability to include cases, typically initiating in rural areas, where fomepizole was not available or test ordering was never attempted, despite presentations of suspected toxic alcohol ingestion. Additionally, reliance on time-stamped case notes from poison center staff introduced subjectivity to the measured outcomes. Limited availability of toxic alcohol testing continues to complicate management of suspected toxic alcohol exposures.

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154. Synthetic angiotensin II administration in the successful management of severe refractory vasoplegic shock due to lamotrigine and quetiapine overdose

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Background: Published experience of synthetic Angiotensin II use in patients with vasoplegic shock due to overdose is limited to a few case reports of toxicity involving ACE inhibitors, clozapine, and tricyclic antidepressants. We report a case of lamotrigine and quetiapine overdose complicated by refractory vasoplegic shock that improved following the addition of a synthetic Angiotensin II infusion.

Case report: A 57 year old male presented to the emergency department unresponsive, tachycardic and hypotensive (initial blood pressure 65/38 mmHg) after being found with empty bottles of quetiapine and lamotrigine. Prehospital naloxone was administered due to the presence of miosis, without improvement. The patient required endotracheal intubation for profound coma. Laboratory analysis revealed lamotrigine serum concentration in the toxic range at 17.8ug/mL (2.5-15ug/mL). Additional laboratory findings included elevated serum lactate of 6.2mmol/L (0-2mmol/L), subtherapeutic lithium concentration of 0.3mmol/L (0.6-1.2 mmol/L), and a nontoxic salicylate concentration of 3.4mg/dL (<30mg/dL) . Acetaminophen, ethanol, methanol and ethylene glycol were not detected. Qualitative toxicology screen was positive for cannabinoids, and negative for amphetamines, benzodiazepines, barbiturates, cocaine, opiates, and phencyclidine. Despite fluid resuscitation with 5 liters of crystalloid, and maximal infusions of epinephrine, norepinephrine, phenylephrine and vasopressin, profound hypotension persisted. Bedside echocardiogram revealed hyperdynamic cardiac activity, normal right ventricular size, a distended inferior vena cava with minimal respiratory variation, and no pericardial effusion. The patient was given 125 units of regular insulin with dextrose supplementation, as well as a total of 350 mL of 20% intralipid as rescue therapy. Neither intervention resulted in any hemodynamic improvement. An infusion of Angiotensin II (20ng/kg/min) was instituted. Within 15 minutes, blood pressure improved from 80/44 mmHg to 106/49 mmHg, and at 30 minutes the blood pressure was 131/54 mmHg. Within six hours, both epinephrine and phenylephrine were discontinued. Angiotensin II and vasopressin were weaned and discontinued over the next 7 hours, followed by norepinephrine. The patient recovered fully from his overdose, and was discharged 8 days after admission with no deficits. He confirmed ingestion of lamotrigine and quetiapine with suicidal intent; and denied any other ingestions.

Discussion: Angiotensin II (Giapreza™; La Jolla Pharmaceuticals, San Diego, CA) is a synthetic vasoconstrictor peptide identical to human hormone angiotensin II. This pharmaceutical was approved by the FDA in 2017 for treatment of hypotension resulting from septic shock. Angiotensin II directly stimulates G-protein-coupled angiotensin type-1 receptors in the peripheral vasculature, resulting in contraction of vascular smooth muscle cells via myosin phosphorylation. The net result is an increase in systemic blood pressure that is independent of any adrenergic or vasopressin receptor activity. Case reports of response in the setting of drug overdose suggest possible benefit from its use when other therapies such as catecholamines and vasopressin are proving ineffective.

Conclusion: In this patient with severe refractory vasoplegic shock from lamotrigine and quetiapine overdose, administration of synthetic Angiotensin-2 was associated with improvement in blood pressure. Further evaluation to determine if synthetic Angiotensin II may represent a therapeutic option for refractory hypotension in the setting of drug overdose is warranted.

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155. Intentional use of hemodialysis to remove baclofen in overdose

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Background: Severe baclofen overdose results in neurologic and respiratory depression, coma, and death. Baclofen may also mimic brain death due to loss of brain stem reflexes. The utility of intermittent hemodialysis (iHD) in baclofen overdose has been proposed, but no definitive guidance is available. We present a case of intentional use of iHD to decrease baclofen concentrations in overdose.
Case report: A 58-year-old female had a witnessed overdose of an unknown amount of hydroxyzine and baclofen at approximately 11:28 AM. She became unresponsive and was brought into an ED while undergoing assisted ventilation. Upon arrival to the ED, she was noted to have GCS 3 with agonal respirations and fixed, dilated pupils. Seizure-like activity was noted with intermittent vomiting, and she was endotracheally intubated. Decontamination was not performed. An EKG revealed normal sinus rhythm with a RBBB and QRS of 158 ms. Initial treatments included lorazepam, magnesium, levetiracetam, and propofol. A sodium bicarbonate bolus was given, and an infusion was started for continued prolonged QRSD. A CT of the head revealed no abnormalities. She was transferred to a tertiary care center ICU.
On hospital day two, MRI of the brain was performed which was unremarkable for acute pathology. Levetiracetam was changed to fosphenytoin. Continuous EEG was initiated which revealed burst-suppression and generalized periodic epileptiform discharges. On hospital day 3, she had anisocoria with a fixed pupil on the right and small, sluggishly reactive pupil on the left, negative dolls-eye reflex, and areflexia. Neurology recommended holding sedation for 24 hours for more accurate neurologic exam. On hospital day 4, pupil exam remained unchanged, and she had no cough, corneal, or gag reflexes. MRI was repeated without any change. On hospital day 5, she was noted to have intact corneal reflexes and sluggish pupils, and EEG appeared "less suppressed," but with continued epileptiform discharges.
Nephrology was consulted and performed intermittent hemodialysis (iHD) for four hours on hospital day 6. Pre- and post-iHD serum concentrations were 85 ng/mL and 43 ng/mL, respectively, (reference 100-400 ng/mL) quantified via LC/MS/MS. Another iHD session was performed on hospital day 8. Her mental status and exam continued to improve until she was ultimately extubated on hospital day 10. She remained hospitalized due to ongoing PT/OT needs and required long-term care.
Discussion: Although the management of baclofen toxicity is primarily supportive, the use of iHD for reducing baclofen concentrations has been reported with favorable outcomes in those patients with renal insufficiency. Our patient had normal renal function when iHD commenced and improvement in her neurologic function following the first iHD session. Interestingly, her mental status was depressed, while serum concentrations were below the reference range before iHD.
Conclusion: In the case of severe baclofen overdose mimicking brain death, iHD decreased serum baclofen concentrations with improvement in neurologic function. Hemodialysis may be considered to shorten the duration of coma. Further study is needed to determine utility of iHD for baclofen overdose in patients with normal renal function.

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156. Desvenlafaxine-associated cardiomyopathy with left ventricular failure after massive overdose

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Background: Desvenlafaxine (o-desmethylvenlafaxine) is the active metabolite of venlafaxine, a bicyclic antidepressant that inhibits neuronal reuptake of serotonin and norepinephrine. Venlafaxine in overdose is known to cause seizure, serotonin toxicity, sympathomimetic cardiovascular effects, and prolongation of QRS and QT intervals. Hypotension and acute cardiomyopathy with reduced ejection fraction (EF) are reported in severely poisoned patients. Experience with desvenlafaxine is limited, and largely extrapolated from venlafaxine. We report a case of status epilepticus, hypotension, QT prolongation, and cardiomyopathy in a patient with a polypharmacy antidepressant overdose that included a large number of desvenlafaxine tablets, along with fluoxetine, trazodone, and diazepam, with confirmatory serum concentrations.
Case report: A 28-year-old female with a history of depression, anxiety, post-traumatic stress disorder, and daily cannabis use presented to the Emergency Department by ambulance after ingesting approximately 76 tablets of desvenlafaxine ER 100mg in a suicide attempt, along with unknown and reportedly lesser amounts of fluoxetine, trazodone, and diazepam. On arrival she was obtunded with a flaccid neuromuscular exam. Initial vital signs were heart rate 94/min, respiratory rate 12/min, blood pressure 99/62 mmHg, temperature 36.2C, and oxygen saturation 98% on room air. ECG showed normal sinus rhythm with QRS 90 ms and QTc 522 ms. Her blood pressure declined and three hours after presentation she had a generalized tonic-clonic seizure, followed by status epilepticus lasting 20 minutes. She was intubated and started on vasopressors for worsening hypotension, ultimately requiring three pressors. Echocardiogram on hospital day (HD) 1 showed severe diffuse hypokinesis with an EF of 28%. A Swan-Ganz catheter demonstrated findings consistent with both left ventricular (LV) failure (elevated pulmonary artery wedge pressure) and vasodilation (low systemic vascular resistance). Pressor requirements declined and LV function slowly improved, with EF of 35% on HD2 and 50-55% on HD 4. QT prolongation resolved on HD 4; QRS remained $<$100 msec on all ECGs. Her hospital course was complicated by aspiration pneumonia, and she was discharged to home on HD 13. Serum desvenlafaxine concentration returned at 7600 ng/mL, with serum fluoxetine and tramadol concentrations both $>$1,000 ng/mL on an antidepressant panel.
Discussion: Little has been reported about desvenlafaxine in overdose, though it is proposed to have less toxicity than its parent compound venlafaxine. Venlafaxine is associated with acute cardiotoxicity, decreased LV function, and cardiogenic shock in large overdoses, sometimes in the absence of significant conduction delay. In this case of a polypharmacy overdose that included a large amount of desvenlafaxine, hypotension and status epilepticus preceded LV failure with markedly depressed EF, consistent with acute drug-induced cardiomyopathy. She was never tachycardic and her QRS remained consistently below 100, indicating cardiotoxicity in the absence of conduction abnormalities. Fluoxetine and trazodone likely contributed to her clinical picture, especially vasodilation, however neither drug is strongly associated with seizure or cardiotoxicity.
Conclusions: In this case of a mixed antidepressant overdose with confirmatory blood levels, desvenlafaxine is associated with acute cardiotoxicity and LV failure in the absence of tachycardia or conduction abnormalities.

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157. The tears of discontent: protest-related lacrimator clinical effects

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Background: While most of the protests in 2020 were peaceful, some demonstrations escalated into riots. For crowd control, law enforcement used aerosolized lacrimators such as capsaicin and tear gas which is made of chloroacetophenone or ortho-chlorobenzylidene malononitrile. These chemical agents intensely irritate the skin and mucous membranes, which temporarily incapacitate the individual. The purpose of this report is to determine the number of lacrimator-related human exposures that occurred during the time of peak protests in 2020 and to describe their clinical effects.
Method: We reviewed all human exposures to lacrimators in a single Poison Center. Inclusion criteria were human cases with the National Poison Data System (NPDS) generic code consistent with lacrimators between May 1, 2020 and September 30, 2020. Only the "related" clinical effects were included; "unknown" and "not related" were excluded. Charts were deemed "protest-related" if the chart text supported exposure at a protest.
Results: There were 91 cases of human exposure to lacrimators in the 5-month study period and 18 (19.8%) were protest-related. Four cases were excluded (3 "not related" clinical effects, 1 "unknown if related"), leaving 14 cases of protest-related exposures. Of the 14 patients, 9 (64%) experienced clinical effects from tear gas; 5 (36%) from capsaicin.
Of the 9 people exposed to tear gas, their clinical effects included dermal erythema/flushed (5/9), ocular irritation (5/9), throat irritation (4/9), dyspnea (4/9), dermal irritation/pain (3/9), cough choke (3/9), hives/welts (2/9), pruritus (2/9), rash (2/9), confusion (2/9), headache (2/9), blurred vision (2/9), dermal edema (1/9), dermal other-flaky (1/9), dizziness/vertigo (1/9), neurological other-foggy thought processes (1/9), lacrimation (1/9), and red eye/conjunctivitis (1/9).
Of the 5 individuals exposed to capsaicin, their clinical effects were dermal irritation/pain (3/5), dermal erythema/flushed (1/5) and ocular irritation/pain (1/5).
Discussion: The clinical effects manifested were consistent with lacrimator exposures. Evidence from this limited review shows that tear gas causes more clinical effects than capsaicin. A more extensive history would provide deeper insight and analysis. For future analyses of lacrimator exposures, it may be helpful to assess whether the individuals have a history of asthma or any other respiratory problems and sensitivity or allergy to the chemicals involved. We need to find out if they wore eyeglasses or any eye-protective gear during the protest. Since the demonstrations occurred during the COVID-19 pandemic season, did the participants wear masks? Did wearing masks impact the percentage of the respiratory-related clinical effects? Could the rate have been higher if the protests occurred during a non-pandemic period?
Conclusion: We found that protest-related human exposures to lacrimators were frequent and caused mucous membrane and eye irritation. Rarely, tear gas and capsaicin exposures are associated with systemic effects.

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158. Successful ECMO treatment of amlodipine and losartan overdose with prolonged hypotension resistant to vasopressors, methylene blue, angiotensin II and high dose insulin

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Background: Calcium channel blocker (CCB) ingestions can be very challenging to manage but dihydropyridine overdoses are relatively benign compared to the other CCB classes. Angiotensin receptor blocker (ARB) overdoses alone rarely result in hypotension. However, a combination of the two medications in overdose can result in severe hypotension.
Case report: A 63 year old man presented to the ED with headache and dizziness 3 hours after ingesting 20-30 pills each of amlodipine 10 mg and losartan 100 mg. His blood pressure (BP) and heart rate (HR) were normal on arrival, but his BP deteriorated to 51/30. He was given activated charcoal, 2 liters of lactated ringers, glucagon, and calcium gluconate. He was started on a norepinephrine infusion, and high dose insulin bolus (1 unit/kg) and infusion (1 unit/kg/hr) with transient improvement of his hemodynamics. Although his mentation remained normal, his BP decreased to the 60's/40's. Norepinephrine was increased to 40 mcg/min and insulin up to 10 units/kg/hr. Additional medications added included: dopamine 20 mcg/kg/min, epinephrine 30 mcg/min, vasopressin 2.4 units/hr, methylene blue 1 mg/kg bolus, angiotensin II 80 ng/kg/min. His lactate increased from 4 mmol/L initially to 9 mmol/L after 10 hours. He developed oliguric acute kidney injury and was started on continuous renal replacement therapy. The next day, echocardiography showed newly reduced left ventricular ejection fraction (EF 30%). Given the persistent shock with multiple end organ injuries, he was intubated and cannulated for venoarterial extracorporeal membrane oxygenation (VA ECMO) and an intra-aortic balloon pump (IABP). His EF improved to 55-60% on hospital day (HD) 5, and he taken off ECMO on HD 8. The vasopressors and IABP were discontinued on HD 12, and he was eventually discharged to a rehabilitation facility.
Discussion: Amlodipine has predominantly vasodilatory effects through its CCB activity and nitric oxide production. ARB binding to AT1 receptors inhibits vasoconstriction and endogenous sympathetic activity as well as blunting exogenous vasopressors.
Conclusion: The combination of dihydropyridine and ARB ingestions may result in severe hypotension resistant to multiple medical therapies including vasopressors, methylene blue, angiotensin II, and high dose insulin therapy. ECMO should be considered early in treatment.

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159. Massive ibuprofen overdose leading to shock, metabolic acidosis, multiorgan failure and coagulopathy

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Background: Ibuprofen, 2-(4-isobutylphenyl) propionic acid, is a nonsteroid drug with anti-inflammatory, antipyretic and analgesic properties. We present a case of massive ibuprofen ingestion in a

patient with impaired metabolism resulting in profound shock and multiorgan failure.
Case report: 29 years old male with a history of a prior suicidal attempt presented to OSH after being found down at around 20:00 hrs with an empty bottle of ibuprofen 800 mg at his side. Per family, the patient went out partying, took molly and then returned home and passed out. He was in a bath tube at time ofEMS arrival. He received Naloxone 6mg without improvement on his mentation. In the emergency department he was comatose and hypotensive with low dose Norepinephrine requirement. He was subsequently intubated and decided to transfer to our facility for higher level of care. His initial set of labs were remarkable for leukocytosis 19 K, GAP metabolic acidosis with ph 7.14, pCO2 33. ASA, APAP and EtOH were undetectable. His Lactic acid was 12.8 and CK 322. His total Bilirubin was 0.2 with AST 79 and ALT 75. CT head without acute abnormalities. Normal COHb level. GC/MS positive for amphetamines. His hemodynamics deteriorates rapidly requiring 3 vasoactive medications at maximal dose (Norepinephrine, Phenylephrine and Vasopressin). His 2D echocardiogram was unremarkable. He was also started on broad spectrum antibiotics and steroids for shock.BCx were negative. Over the following days he developed worsening coagulopathy, renal failure and liver function test that peak at day 3. His 12 hours Ibuprofen levels were 320 mcg/ml (upper limit 30 mcg/ml), 16 hour level was 350 mcg/ml and 31 hour level post ingestion was 170 mcg/ml. His inopressors started down-titrating by day 2 of hospitalization and he was completely off vasoactive medications by day 3. Pharmacogenetic report was performed that showed a CYP 2C9 *1/*3, intermediate metabolizer consistent with moderate deficiency in CYP2C9 enzyme activity. He was discharged home by day 9 of hospitalization
Discussion: Ibuprofen mediates its therapeutic effects by reversible binding of cyclooxygenase (COX) receptors (COX1 and COX2 isoforms) on prostaglandin synthesis, preventing the conversion of arachidonic acid to various prostaglandins. The vast majority of ibuprofen overdose remains asymptomatic however occasionally massive ingestion may lead into coma, shock, acidosis, renal failure and rarely death. Our patient developed profound shock with AKI, hepatotoxicity and coagulopathy that improved with supportive therapy. His ibuprofen level peaked at least 16 hours post ingestion and his pharmacogenomic studies were compatible with intermediate metabolizer for CYP 2C9 that implies an impaired metabolism of the parent compound that possible play a role on his clinical presentation.
Conclusion: Acute ibuprofen overdose results in a wide range of clinical effects, most of which are minor in severity however massive ingestion in intermediate or slow metabolizers may lead to profound shock, acidosis and multiorgan failure.

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160. ST elevation and rapid onset rhabdomyolysis after suicidal ingestion with hydrochloric acid

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Background: Suicidal ingestion of high concentration hydrochloric (muriatic) acid is rare but a life-threatening event. We report a fatal case of initially stable patient who develop rapid multiorgan failure including potential myocarditis with ST elevation and rhabdomyolysis after a suicidal ingestion of hydrochloric acid (HCl).
Case report: 40 years old male patient with no prior medical history was brought to emergency room after being found in the aisle of a hardware store drinking muriatic acid (hydrochloric acid 14.5%) for pools. He drank approximately 1 glass full. Patient denies taking any other medications to hurt himself. On Admission, he was complaining of mouth pain with excessive drooling and vomiting. Initial vitals showed BP 150/90 mmHg, HR 70, O2 sat between 91 %, Temp 98 , RR 24. Endotracheal intubation was performed for airway protection. Gross hematuria was noticed after Foley catheter insertion. Initial set of labs were remarkable for normal WBC count, thrombocytopenia 113 K, GAP metabolic acidosis (17) with normal chloride of 101 mg/dl and Lactic acid of 2.1. His serum creatinine was 1. His CK was elevated at 13,275. His LFT showed elevated total Bilirubin 2.4, AST 1137 and ALT 421. His hsTrop was normal at 27. PT was 12.7. Emergent EGD was performed in the ED showing a significant diffuse esophageal necrosis. CT Chest, abdomen and pelvis showed fluid distended esophagus and faint ground glass opacities in the right upper lobe, no extraluminal gas was evidenced. His ECG showed ST elevation in inferior leads (II, II, aVF). Over the subsequent 6 hours, his clinical status deteriorated developing shock with requirement of 4 inopressors. His hsTrop increased to 3,524. His ph was 7.0 and pCO2 38, worsening leukocytosis to 15 K, LFT (T bili 10) and renal function (sCr 2.6 mg/dl). His urine GC/MS showed methamphetamines. He finally developed 2 episodes of cardiac arrest (PEA) and died 9 hours post ingestion and 8 hours post admission.
Discussion: HCl is highly corrosive and generally causes coagulation necrosis which could lead to GI perforation. Intentional ingestion of HCl in the setting of clinical symptoms and metabolic abnormalities requires a rapid endoscopic evaluation to determine early prognostication. Few cases of ST elevation predominantly in inferior leads after a severe mucosal damage or perforation with HCl ingestion have been reported. The intimate contact between gastric fundus and the inferolateral wall of the heart points toward an acute caustic myocarditis induced by direct contact between necrotic upper gastrointestinal tract and pericardium. Rapid onset rhabdomyolysis on presentation was probably multifactorial given the severe inflammatory state but a direct injury to the diaphragm could not be completely rule out.
Conclusion: Based on literature review of suicidal attempt with hydrochloric acid, prognosis appears to be dismal in patients with systemic complications (severe metabolic acidosis, hepatotoxicity, DIC or ST elevation) in the setting of advanced Zargar Endoscopic grading classification (3 or more).ST elevation in inferior leads may imply a caustic myocarditis by contiguity.

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161. Mother of all MAMAs: multidisciplinary care resulting in survival of patient with record-breaking metformin level

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Background: Metformin is a biguanide oral anti-hyperglycemic agent that is renally eliminated. Accumulation of metformin, either due to excess ingestion or decreased elimination can

cause metformin-associated metabolic acidosis (MAMA). MAMA is defined as pH <7.35 with lactate >5 mmol/L in the setting of metformin exposure. Metformin levels can confirm the diagnosis, although results are typically not available within a clinically-relevant timeframe. A therapeutic metformin level is 1-2 mcg/mL, while >5 mcg/mL is consistent with MAMA.
Case report: A 32-year-old female with past medical history of type 2 diabetes, anxiety, and depression presented to a community hospital 1 hour after intentional ingestion of approximately 90 g of metformin, and 60 tablets of acetaminophen- diphenhydramine 500mg-25mg tablets. Her laboratory studies 90 minutes post ingestion showed an acetaminophen level of 240, a lactate of 11 mMol/L, bicarbonate of 9.4, creatinine of 0.9 mg/dL and venous pH of 7.2. Initial EKG showed sinus tachycardia with a rate of 116 with a QRS of 90 msec and QTc of 530. She developed altered mental status requiring endotracheal intubation 2 hours after presentation. She was started on N-acetylcysteine and transferred to tertiary care facility for toxicology evaluation.
Patient arrived at the tertiary care center approximately 5.5 hours post ingestion. Her labs showed an arterial pH of 6.86, lactate of 23mMol/L, acetaminophen level of 275, bicarbonate of 9, and creatinine of 1.5mg/dL. A metformin level was sent. The diagnosis of MAMA was made based on her pH, lactate, and metformin exposure. A temporary hemodialysis catheter was placed in the emergency depart and nephrology started patient on hemodialysis (HD) with 25 rex dialyzer and high bicarbonate bath of 30 meq/L. Hemodialysis was started approximately 8 hours post ingestion and was continued for a total of 47 hours and 45 minutes, until patient's lactate was 3 mmol/L.
Patient eventually recovered and was discharged to inpatient psychiatric care. Her initial metformin level eventually resulted at 470 mcg/mL and her post HD metformin level was 8.5 mcg/mL.
Discussion: This case illustrates the successful treatment of a patient with the highest-ever recorded non-fatal metformin level. A multidisciplinary approach was required given the significant potential for complications. Major concerns included the patient's altered mental status requiring a secured airway and mechanical ventilation, precarious acid-base status, need for prolonged HD for adequate clearance, and the need to aggressively manage electrolytes to safely allow for a close to 12x longer than typical run of hemodialysis. In addition to the primary team of medical toxicologists coordinating and directing care, nephrology managed an exceptionally long hemodialysis treatment with multiple electrolyte supplementations and dialysate bath adjustments. Meanwhile critical care medicine contributed with corresponding specific adjustments to hemodynamic support, sedation, and ventilator settings.
Conclusions: This case demonstrates the importance of a coordinated multidisciplinary approach to draw on different specialists' areas of expertise in extreme or unprecedented cases. Additionally, this case proved the safety and efficacy of prolonged hemodialysis treatment of close to 48 hours.

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162. Dexmedetomidine for sympathomimetic toxicity due to venlafaxine overdose

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Background: Venlafaxine overdose has been noted to have higher rates of morbidity and mortality as compared to other antidepressants due to its cardiac toxicity and sympathomimetic effects. Dexmedetomidine is an alpha-2 adrenergic agonist and results in sympatholysis.
Case report: This is a single patient case report. A 19-year-old nonbinary individual presented to the emergency department after an ingestion of approximately 3,000 mg of XR venlafaxine. The patient developed gradually worsening tachycardia with a HR of 150 bpm, diaphoresis, slurred speech, mydriasis and nystagmus without extremity rigidity or clonus. EKG showed sinus tachycardia with a rate of 147, QRS of 88 ms and QTC of 402 ms. They were given 50 mg of IV diazepam with resulting sedation but minimal improvement in heart rate of diaphoresis.
They were moved to the ICU and dexmedetomidine infusion was initiated by toxicology service for direct sympatholysis. The dexmedetomidine infusion was titrated up to a maximum dose of 0.8 mcg/kg/min and resulted in improvement in HR to 112 bpm and resolution of diaphoresis. This was titrated off over 12 hours and the patient's toxicity resolved. Though venlafaxine is known to cause sodium channel blockade, no evidence of QRS prolongation was noted in this patient.
Discussion: While benzodiazapines remain the cornerstone of treatment of sympathomimetic overdoses, alternative and adjunctive agents can be helpful components of mangement. In this case specifically, the patient was adequately sedated after benzodiazapine administration but remained severely tachycardic. Use of low-dose Dexmedetomidine allowed for successful treatment of the tachycardia associated with sympathomimetic excess without resulting in increased sedation or respiratory depression.
Conclusion: Dexmedetomidine infusion can lead to rapid improvement in sympathomimetic symptoms secondary to venlafaxine overdose and may be considered as an adjunctive therapy for symptomatic venlafaxine ingestion that is refractory to benzodiazepine administration.

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163. Comparing clinical features of benzodiazepine overdoses: a review of the Toxicology Investigators Consortium registry

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Background: Benzodiazepines are sedative-hypnotic medications that are commonly encountered by medical toxicologists. They elicit their effects through activity at the benzodiazepine receptor and are typically amenable to competitive reversal through administration of flumazenil. There are very few studies comparing clinical characteristics of toxicity between different agents within the benzodiazepine class. The objective of this study is to compare the frequencies of adverse effects and use of treatments following ingestion of various benzodiazepines.
Methods: This is a retrospective review of all available single-substance benzodiazepine ingestions entered into the Toxicology Investigators Consortium Registry from January 2010 through December 2020. Frequencies are reported as percentages and

statistical significance was determined using the Chi-Square or Fisher's exact test, where appropriate.
Results: From the available registry data, there were 887 single-substance benzodiazepine ingestions. Of those 887 cases, the most commonly ingested benzodiazepines were alprazolam (n = 303, 34.2%), clonazepam (n = 281, 31.7%), and lorazepam (n = 148, 16.7%). All other benzodiazepines were considered together as "other" (n = 155, 17.5%). Alprazolam ingestions were associated with significantly higher rates of central nervous system (CNS) depression than other benzodiazepine ingestions (71.9% vs 59.1%, $p < 0.001$). Patients with lorazepam ingestions were treated significantly more often with flumazenil than other ingestions (18.2% vs 10.2%, $p < 0.01$). Those who received "other" benzodiazepines were associated with lower rates of CNS depression (54.8% vs 65.3%, $p < 0.05$) but higher rates of intubation (12.3% vs 6.8%, $p < 0.05$).
Discussion: Benzodiazepine ingestion can result in CNS and respiratory depression, need for endotracheal intubation, and rarely bradycardia and hypotension. Our data show that alprazolam ingestions result in significantly higher rates of CNS depression than other benzodiazepine ingestions, which is consistent with previous literature on alprazolam. Our data also demonstrated that flumazenil was given more often following lorazepam ingestions when compared to other benzodiazepine ingestions.
Conclusion: Alprazolam toxicity results in higher rates of CNS depression in overdose compared to other benzodiazepines. Toxicologists may be more likely to treat lorazepam overdoses with flumazenil compared to other benzodiazepine ingestions. While the reason for this discrepancy is unclear, future studies may help to further characterize differences in presentation and treatment of benzodiazepine ingestions.

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164. Caustic ingestions: does the reason for ingestion matter?

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Background: Despite being a commonly encountered class of ingestions, there is considerable variability in the management of caustic ingestions. Frequently, patients who ingest a caustic agent in a suicide attempt undergo esophagogastroduodenoscopy (EGD), regardless of symptoms, given concern over large volumes likely to be ingested in suicidal patients, and a perceived increased risk of injury. However, it is not clear if such an approach is indicated. This study sought to determine the rate of clinically significant injury among patients, including suicidal patients, who are asymptomatic.
Methods: This retrospective, multicenter study evaluated caustic ingestions occurring between 1 January 2014 through 31 December, 2020 at 9 locations in three countries. Subjects were identified via search of ICD 9 and ICD 10 diagnosis. Symptoms were defined as the presence of pain, dysphonia, drooling, or need for intubation (other than for an EGD). Patients were considered to have non-significant injuries if an EGD was performed and grade 0, I, or IIa lesion was present, or if follow-up information is noted at least 30 days after the initial injury and the patient had no surgical interventions during that time. Subjects were excluded if there was a mix of caustic ingestions (an acid and a base ingested), or if the agent was unknown.
Results: A total of 197 subjects who met inclusion criteria. The median (IQR) age of 17 (3-30) years, with males accounting for 103 (52.3%) of subjects. Basic substances were more prevalent than acidic substances (85.3 vs. 14.7%). Symptoms were present in 97 (51.3%) of cases. One month follow up data or EGD was available on 158 (80.2%) of subjects. No significant injury was noted in 150/158 (94.9%) of subjects. Among the 8 (5.3%) individuals who had significant injury, all were symptomatic. Thus, the rate of significant injury among patients who are asymptomatic was 0% (97.5% CI 9-5.3). In contrast, 8 of the 88 patients who were symptomatic had severe injury (9.09%, 95% CI 4-17.1%). Suicidal ingestions accounted for 77 (39.1%) of all ingestions. Among the non-suicidal patients, 44 (47.3%) were symptomatic and 49 (52.6%) were symptomatic. None of the asymptomatic suicidal patients had significant injury (0%, 97.5% CI 0-8.4%), compared with 7 (14.2%, 95% CI 5.9-27.2%) of symptomatic suicidal patients had significant injury. Patients with acidic ingestions did not undergo EGD at any different rate than alkali ingestions
Conclusion: Caustic ingestions are a common source of suicidal ingestions. Suicidal patients are not at higher risk of developing significant injury. Routine EGD may not be necessary in asymptomatic individuals.

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165. Severe coagulopathy and progression of swelling due to *Sistrurus miliarius streckeri* envenomation following F(ab')2 antivenom treatment

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Background: We have previously reported a treatment failure of the western pygmy rattlesnake (Sistrurus miliarius streckeri) following the administration of Crotalidae Polyvalent Immune Fab (CroFab®). This recurrence was treated with polyvalent equine anti-viper $F(ab')_2$ (Antivipmyn TRI®) with rapid resolution of coagulopathy. Currently there are two antivenoms available for rattlesnake envenomations in the U.S., Fab (CroFab®) and $F(ab')_2$ (ANAVIP®). Due to the longer plasma half life of $F(ab')_2$, it has been reported that patients treated with $F(ab')_2$ do not develop delayed and recurrent coagulopathy. Both delayed and recurrent coagulopathy are concerns when treating patients after western pygmy rattlesnake envenomation. We report a patient who developed abnormalities in his coagulation studies and progression of swelling after the administration of $F(ab')_2$.
Case report: A 54-year-old male presented to the emergency department (ED) one hour following envenomation on the thumb by a confirmed western pygmy rattlesnake. Swelling was limited to the immediate area and pain was minimal. Within one hour the swelling had increased into the wrist and pain was severe. Coagulation studies at that time showed a protime of 10.9, INR of 1.0, a platelet count of 363 x 10^3 per μL, and fibrinogen of 403 mg/dL. The patient was given 10 vials of $F(ab')_2$ 2 hours after the bite. Follow-up laboratory analysis at 4 hours after the bite again demonstrated a protime of 11.14, an INR of 1.0, a PTT of 29.5, platelet count of 322 x 10^3 per μL, fibrinogen of 360 mg/dL and a d-Dimer of 337. Due to swelling to the mid forearm, the patient was given 6 vials of Fab at 18 hours after

the bite.
On 21-hour follow-up, coagulation studies showed that the protime was 25.9, INR was now 2.3 with a platelet count of 236 x 10^3 per μL. Fibrinogen was less than 40 and d-Dimer was 262 mg/L. The patient then received ten vials of Fab at 22 hours post bite. Three hours following Fab administration the protime was 11.2, PTT 29.6, platelet count of 331 x 10^3 per μL, and a fibrinogen of 530 mg/dL. Three hours after the 10 vial bolus of Fab, the patient was started on maintenance Fab therapy and received 2 vials every 6 hours for 3 doses. On follow-up the next morning all laboratory evaluation was unremarkable: protime 11.8, INR 1.1, PTT 27.8, platelets 286, fibrinogen 520 mg/dL and d-Dimer 368 mg/L.
Conclusion: Envenomation by the western pygmy rattlesnake remains a significant problem with coagulopathy and can have severe coagulation recurrence after treatment with either Fab or $F(ab')_2$ antivenom. Reversal with the alternative antivenom was effective suggesting some unique effect of combination or a need for larger doses for this rattlesnake.

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166. Massive zinc citrate overdose

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Background: During the 2019 novel coronavirus (COVID-19) pandemic, many people were using medications, vitamins, and supplements to ward off infection. Zinc is an essential, heavy metal micronutrient supplement which plays a role in cell growth and repair. Zinc was one such remedy touted to prevent COVID-19 infection. This is a case of a massive zinc citrate overdose.
Case report: A 36-year-old male presented to the emergency department after unintentionally ingesting 15-22 grams of zinc citrate "to avoid contracting COVID". The patient reported he was unsure how to measure the product's recommended dose of 150 mg, so he guessed and ingested three tablespoons. Within two hours of the ingestion, he developed nausea, abdominal pain, headache, tremors, and had four episodes of non-bloody emesis. Initial vitals were: 98.2 degrees, BP 133/92 mmHg, HR 88, RR 17, 99% oxygen saturation on room air. He was tremulousness and uncomfortable appearing but with otherwise normal physical exam. Poison Control was contacted and recommended: whole bowel irrigation, an abdominal x-ray, ECG, serum copper level, serum zinc levels every six hours in addition to a routine toxicologic work up. The patient was treated with 4mg IV Zofran and received 1L of NS and 2L of polyethylene glycol per hour until clear rectal effluent. Zinc levels were 489.5mcg/Dl and >800mcg/Dl at three hours and fourteen hours post ingestion respectively (normal 60-120mcg/Dl). He was discharged after one night with outpatient follow up.
Discussion: Zinc supplements are often sold over the counter as prophylaxis and treatment for upper respiratory infections and represent a common avenue for unintentional over supplementation. Zinc is naturally obtained though ingestion of meats and is absorbed in the duodenum and jejunum. In the liver, it binds to metallothionine with a higher affinity than copper and can lead to copper deficiency. Data on its use is inconclusive and is currently not advised. Recommended intake is approximately 15mg/day in adulthood. Intake of up to 100mg/day is generally not associated with adverse events; chronic intake greater than 150mg/day may lead to toxicity. Activated charcoal is not well suited for heavy metals and is not recommended. Whole bowel irrigation mitigates some absorption if initiated early. For large overdoses of readily absorbed formulations, chelation with calcium disodium ethylenediaminetetraacetate (CaNa2EDTA) should be initiated. Zinc overdose commonly results in gastrointestinal upset and headache. Salt formulations like zinc-chloride are the most toxic as they are water soluble with a high titratable acid reserve, leading to severe side effects including kidney injury, neurologic deficits, and seizures. Common formulations that are less readily absorbed like zinc-citrate can lead to copper deficiency, creating a myeloneuropathy of the dorsal columns and long-term proprioceptive deficits. Patients should be admitted and managed closely with a toxicologist since this is a rare toxicity. They will also require prolonged outpatient follow up and may require copper supplementation.
Conclusion: The COVID-19 pandemic has led to an increase in supplementation use, commonly without physician guidance, which has led to significant toxicities. This case may represent the highest oral overdose of zinc reported in the literature.

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167. Pediatric hydrangea ingestions reported to poison centers

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Background: The genus *Hydrangea* (common names hydrangea or hortensia) contains 70 or more species native to Asia and the Americas. The plants are usually bush-like in shape and grow 1-3 meters in height. *Hydrangea* flower in spring to late autumn. Most species produce white flowers, although some produce blue, red, or purple flowers. The flowers grow in flowerheads and consist of two types: small non-showy flowers in the center of the flowerhead and large, showy flowers with large, colorful sepals. *Hydrangea* may be toxic to humans and certain pets. The leaves and flowers of the plant contain the cyanogenic glycosides taxiphyllin and hydracyanoside, which are converted to cyanide in the gastrointestinal tract. Hydrangin is often cited as the primary toxin, but it contains no cyanide structures and is a member of the coumarin family. Ingestion of *Hydrangea* may result in nausea, vomiting, and diarrhea. The objective of this study was to describe *Hydrangea* ingestions among young children reported to poison centers.
Methods: Cases were all *Hydrangea* ingestions among patients age 5 years or less reported to a statewide poison center network during 2000-2020. *Hydrangea* ingestions were identified by review of records with "hydrangea" in the Substance code description field. The distribution of pediatric *Hydrangea* ingestions was determined for various factors related to patient demographics, ingestion circumstances, management, and outcome.
Results: A total of 111 *Hydrangea* ingestions involving young children were identified. The part(s) of the plant ingested were the leaf (n= 45, 40.5%), flower (n= 25, 22.5%), stem (n = 2, 1.8%), and unknown (n = 39, 35.1%). The season of exposure was 21 (18.9%) January-March, 58 (52.3%) April-June, 19 (17.1%) July-September, and 13 (11.7%) October-December. The patient age distribution was 53 (47.7%) < 1 year, 29 (26.1%) 1 year, 17 (15.3%) 2 years, 7 (6.3%) 3 years, and 5 (4.5%) 4 years; 57 (51.4%) of the patients were male and 54 (48.6%) female. The ingestion site was 103 (92.8%) patient's own residence, 3 (2.7%) another residence, 3 (2.7%) public area, and 2 (1.8%) unspecified other site. All of the ingestions were unintentional. Other substances were involved in 2 (1.8%) of the ingestions. One hundred ten (99.1%) of the patients were managed on-site and 1 (0.9%) was already at/en route to a healthcare facility. The medical outcome was 34 (30.6%) no effect, 10 (9.0%) minor effect, 10 (9.0%) not

followed-judged nontoxic, 54 (48.6%) not followed-minimal clinical effects possible, 1 (0.9%) unable to follow-potentially toxic, and 2 (1.8%) unrelated effect. A clinical effect was reported in 20 (18.0%) of the ingestions. The most frequent clinical effect was vomiting (n = 14, 12.6%). The most frequent treatments were dilute/irrigate/wash (n = 86, 77.5%) and food/snack (n = 15, 13.5%).
Conclusion: Pediatric *Hydrangea* ingestions most often involved the leaf. The ingestions were seasonal, peaking in April-June. The majority of ingestions involved children age 1 year or less. Most *Hydrangea* pediatric ingestions were managed outside of a healthcare facility and did not result in a serious outcome.

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168. Lightly irritating effects to chlorine exposures

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Background: Chlorine is a yellow-green gas with a pungent odor. Mixture of chlorine bleach with other household products containing acid or ammonia is a common source of chlorine gas exposure. Exposures to chlorine gas can occur by inhalational, ocular, or dermal routes. Symptoms of mild exposure include cough, dyspnea, chest pain, ocular/nasal/throat irritation, watery eyes, blurry vision, dizziness, nausea, and vomiting. Moderate/severe exposures may result in laryngitis, wheezing, stridor, and laryngeal edema. This study aimed to describe chlorine exposures managed at United States (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a statistically valid injury surveillance and follow-back system comprising a database of consumer product-related injuries collected from EDs of approximately 100 representative 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. In order to identify chlorine exposures reported during 2000-2019, all records with the letter combination "chlor" in the mentioned narrative were reviewed, and those that appeared to be chlorine exposures were included in the study. The distribution of estimated chlorine exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.
Results: A total of 1,735 chlorine exposures were identified, resulting in a national estimate of 74,343 exposures. By four-year periods, there were 15,818 (21.3%) exposures during 2000-2003, 14,137 (19.0%) during 2004-2007, 12,716 (17.1%) during 2008-2011, 16,168 (21.7%) during 2012-2015, and 15,504 (20.9%) during 2016-2019. The distribution by season was 6780 (9.1%) in December-February, 16,700 (22.5%) in March-May, 39,607 (53.3%) in June-August, and 11,256 (15.1%) in September-November. Patient age distribution was 10,506 (14.1%) 0-5 years, 14,438 (19.4%) 6-12 years, 6,688 (9.0%) 13-19 years, and 42,710 (57.5%) 20 years or older; 43,489 (58.5%) of the patients were male, 30,775 (41.4%) female, and 78 (0.1%) unknown sex. The route of the exposure was 30,304 (40.8%) inhalation/aspiration/nasal, 24,203 (32.6%) ocular, 12,233 (16.5%) dermal, 3,893 (5.2%) ingestion/oral, 60 (0.1%) injection, and 24,203 (32.6%) unknown. The circumstance of the exposure was 24,812 (33.4%) being in a swimming pool/hot tub, 13,807 (18.6%) working with swimming pool/hot tub chemicals, 9,439 (12.7%) exposure to household cleaning products, and 26,285 (35.4%) other/unknown. The reported location where the exposure occurred was 40,022 (53.8%) home, 5,616 (7.6%) place of recreation or sports, 4,228 (5.7%) other public property, 746 (1.0%) school, and 23,730 (31.9%) not recorded. Most common diagnoses were 33,021 (44.4%) poisoning, 18,972 (25.5%) dermatitis/conjunctivitis, 11,187 (15.0%) chemical burn, 2,271 (3.1%) anoxia, and 1,554 (2.1%) contusion/abrasion. The patient disposition was 69,576 (93.6%) treated or examined and released, 772 (1.0%) treated and transferred to another healthcare facility, 2,856 (3.8%) treated and admitted for hospitalization, 405 (0.5%) held for observation, 728 (1.0%) left without being seen, and 6 (0.0%) not recorded.
Conclusion: Most patients reporting chlorine exposures treated in EDs involved males, adults, the inhalation route, and dermatitis/conjunctivitis. The majority of patients were treated and released from the ED.

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169. Itching rise in *Toxicodendron radicans* exposures

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Background: *Toxicodendron radicans* (poison ivy) grows as a woody vine or small shrub. Leaves can have smooth or serrated edges, rounded or pointed tips, be shiny or dull, but always consist of three leaflets. Its leaves change colors depending on the season but remain poisonous year-round. *T. radicans* produces urushiol, an allergenic oleoresin, which is a mixture of alkylcatechols found in all parts of the plant. Urushiol exposures cause allergic contact dermatitis directly by plant contact or indirectly by contact with the oil—characterized initially by intense pruritus followed by erythema. As dermatitis progresses, vesicles form and often erupt in linear streaks corresponding to the contact points with the plant. The dermatitis is usually self-limiting. This study aimed to identify *T. radicans* exposures managed at United States (US) emergency departments (EDs).
Methods: Data were obtained from the National Electronic Injury Surveillance System (NEISS), a statistically valid injury surveillance and follow-back system comprising a database of consumer product-related injuries collected from EDs of approximately 100 representative 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 *T. radicans* exposures reported during 2000-2019, all records with the letter combinations "poi" and "ivy" in the recorded narrative were reviewed, and those that appeared to be *T. radicans* exposures were included in the study. The distribution of estimated *T. radicans* exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.
Results: A total of 988 *T. radicans* exposures were identified, resulting in a national estimate of 42,469 exposures. By four-year periods, there were 9,385 (22.1%) exposures during 2000-2003, 9,046 (21.3%) during 2004-2007, 5,877 (13.8%) during 2008-2011, 6,275 (14.8%) during 2012-2015, and 11,887 (28.0%) during 2016-2019. The distribution by season was 568 (1.3%) in December-February, 9,304 (21.9%) in March-May, 25,035 (58.9%) in June-August, and 7,561 (17.8%) in September-November. Patient age distribution was 1,031 (2.4%) 0-5 years, 4,527 (10.7%) 6-12 years, 7,703 (18.1%) 13-19 years, and 29,208 (68.8%) 20 years or older; 30,398 (71.6%) of patients were male and 12,071 (28.4%) female.

The reported location where the exposure occurred was 20,303 (47.8%) home, 6,852 (16.1%) place of recreation or sports, 1,172 (2.8%) other public property, 910 (2.1%) farm/ranch, 241 (0.6%) other, and 12,990 (30.6%) not recorded. Reported clinical effects were 39,864 (93.9%) dermatitis, 318 (0.7%) allergic reaction, 191 (0.5%) conjunctivitis, 187 (0.4%) cellulitis, 126 (0.3%) edema, 40 (0.1%) pain, and 16 (0.0%) respiratory distress. The affected body part was 11,336 (26.7%) upper extremity, 10,690 (25.2%) head/neck, 6,393 (15.1%) lower extremity, 3,726 (8.8%) trunk, and 10,323 (24.3%) other/not recorded. The patient disposition was 42,161 (99.3%) treated or examined and released, 149 (0.4%) treated and admitted for hospitalization, and 158 (0.4%) left without being seen/against medical advice.
Conclusion: *T. radicans* exposures have increased since 2008. The majority involved adults, males, dermatitis, and an upper extremity or the head/neck region. Almost all cases were minor and were discharged.

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170. In cold blood: observational descriptive case series of Eastern Massasauga rattlesnake bites reported to a state poison center

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Background: The Eastern Massasauga rattlesnake (*Sistrurus catenatus catenatus*) is a small-to-medium sized reclusive and relatively docile pit viper indigenous to the Great Lakes region. Scant literature exists characterizing toxicity following envenomation, with few reports describing severe clinical effects. We present the largest known descriptive case series of Eastern Massasauga rattlesnake bites in humans reported to a single poison center over 18 years. We include clinical manifestations, course of antivenom therapy, and incidence of late or recurrent coagulopathies.
Methods: This was a retrospective observational case series involving Eastern Massasauga rattlesnake bites reported to a single poison center. We queried our poison center database for cases involving snake bites from January 1, 2003 to December 31, 2020. De-identified cases were then reviewed based on predefined search criteria. Inclusion criteria involved all human envenomations from the Eastern Massasauga rattlesnake; all ages and both sexes were included. Exclusion criteria included envenomations from other snake species, non-human envenomations, and information request calls. The degree of envenomation was graded according to our institutional guideline, which was a modified version derived from a validated snakebite severity score system. The type of coagulopathy was classified according to specific observational criteria derived from a previous toxicologic report evaluating pit viper envenomations. Recurrent coagulopathies were recognized within the first 12 hours, followed by normalization, however with recurrence at a later time. Late coagulopathies occurred 12 hours or more following first antivenom administration. This study was approved by the local Institutional Review Board.
Results: A total of 75 cases met inclusion criteria. The majority of subjects (60/75) were males. The median age was 38 years. The most frequent clinical signs and symptoms were edema (56 cases), pain (31), and erythema (16). The most common bite location was on the hands or fingers (40 cases). Bleeding was rare, with two significant bleeding events including one in an individual on anticoagulation medication. One case underwent a fasciotomy. Moderate-grade envenomations were most common (32 cases), followed by minimal (24) and severe (6), with 10 cases classified as having no envenomation. Forty cases involved antivenom administration; crotalidae polyvalent immune fab was administered most frequently (38 cases), one case involved antivenin crotalidae polyvalent, and one case was unconfirmed regarding specific antivenom administered. The average number of vials of crotalidae polyvalent immune fab administered, where recorded, was 13. Nine cases reported adverse effects following antivenom administration; fever (22%) and hives (22%) were the most frequent. Serum sickness was reported in one case following antivenin crotalidae polyvalent administration. Three cases reported recurrent coagulopathy and one with late coagulopathy. No deaths were reported.
Conclusion: The Eastern Massasauga rattlesnake is the only venomous snake native to our state. Human envenomations following Eastern Massasauga rattlesnake bites can result in clinically significant toxicity; however, typically resolve with timely crotalidae antivenom administration. Severe, late, or recurrent coagulopathies are rare.

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171. Severe boric acid toxicity presenting as pseudosepsis and complicated by mediastinal, esophageal, and colonic corrosive injury

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Background: Boric acid is a common household product, utilized as a roach killer and personal hygiene agent. Exposure is generally benign. The most frequent route of exposure is ingestion. It is also well-absorbed dermally. Classic signs and symptoms are: 'boiled lobster' rash followed by exfoliative dermatitis as well as nausea, blue vomit, diarrhea, and abdominal pain. The exact mechanism of action is unknown.
Severe poisonings reported include hypovolemic shock, decreased mental status, and seizures. Though rare, death is suspected from severe dehydration. Gastrointestinal volume losses lead to prerenal azotemia compounded by acute tubular necrosis with renal failure. Corrosive injury is an additional concerning complication. Severe toxicity have been managed with hemodialysis, forced diuresis, and cardiopulmonary bypass.
Case report: 41-year-old female presented to the emergency department of a large urban hospital about 12 hours after an acute intentional ingestion of 3 cups of boric acid. She had epigastric abdominal pain with blood-streaked emesis. Physical exam was pertinent for dry oral mucosa and diffusely tender abdomen. She denied any concomitant ingestion.
On arrival, the patient presented with vitals and labs concerning for sepsis: tachycardia (126 bpm), hypotension (74/47 mmHg), metabolic acidosis (pH 7.35, bicarbonate 18mmol/L, on venous blood gas; bicarbonate 15 mmol/L and anion gap 20 mmol/L on basic metabolic panel), and an elevated lactic acid level (7.1 mmol/L). Hemoglobin and hematocrit were normal at 13.3 g/dL and 39.7%. Urine drug screen (amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, and phencyclidine) was negative. Acetaminophen, salicylate, and ethanol levels were undetectable. Lithium level was also undetectable (<0.1mmol/L). Despite 5 liters of fluid resuscitation, hypotension

persisted; norepinephrine infusion was started. Lactic acidemia persisted despite aggressive resuscitation. Serum creatinine was 1.64 mg/dL (baseline 0.69 mg/dL). She was treated with ceftriaxone 1 gram IV and metronidazole 500 mg IV given concern for sepsis. She was admitted to the ICU.
Hospital course was notable for 2 negative blood cultures and no focal source of infection. Urine boric acid returned at >80 mg/L (normal <5 mg/L) on day 1 of admission. She clinically improved.
Discussion: Our case presented in shock due to volume depletion from persistent emesis after boric acid ingestion. Unlike previous reported cases of severe boric acid toxicity, hemodialysis or forced diuresis was not required. She recovered fully 3 days later including normal renal function and lactate clearance. In addition, our case was concerning for boric acid corrosive injury given her presentation. The CT images demonstrated diffuse mediastinitis, esophagitis and colitis. An upper endoscopy identified Los Angeles grade C esophagitis. Although our patient presented with many of the classic findings of boric acid toxicity including a desquamative rash with vomiting and abdominal pain, her clinical course was complicated by mediastinal, esophageal, and colonic corrosive injury.
Conclusions: Boric acid exposure is typically low-risk to patient morbidity and mortality. Severe exposures can require invasive treatment. Despite the severity of toxicity, our case was responsive to simple supportive treatment. Additionally, she had extensive corrosive injury requiring future scheduled endoscopic surveillance for strictures and carcinoma. When evaluating severe boric acid toxicity, early aggressive resuscitation is important as well as evaluating the patient for corrosive injury.

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172. Repeated physostigmine administration for quetiapine toxicity complicated by benzodiazepine withdrawal

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Background: Quetiapine toxicity can cause a delayed and often profound anticholinergic toxidrome due to the formation of the active metabolite N-desalkyl quetiapine. Herein we present a woman who developed quetiapine toxicity in the setting of benzodiazepine withdrawal that received 22 mg of physostigmine with intermittent bolus dosing of diazepam over the course of 24 hours for anticholinergic delirium.
Case report: A 48-year-old woman with borderline personality disorder and chronic benzodiazepine use was brought to the Emergency Department (ED) via paramedics with attemped suicide via ingestion of an unknown amount of quetapine and clonazepam at an unknown time. She was regularly taking 8 mg of clonazepam daily.
ED vitals were: temperature 37.5 °C, pulse 110 beats/minute, blood pressure 98/50 mmHg, respiratory rate 16 breaths/minute, SpO2 98%. On exam she was lethargic, disoriented, and had slurred speech. Significant laboratory studies included a lactate of 4.1 mEq/L and serum ethanol 0.09 g/dL. Urine drug screen immunoassay was positive for benzodiazepines with the GC/MS positive for quetiapine. Head CT and other laboratory studies were normal or unremarkable.
She was initially admitted to the floor, however, over the next 12 hours became progressively more agitated and delirious, tachycardic (to the 120-140s), hypertensive (systolic blood pressure to 170s), and febrile (to 38.5 °C) which prompted ICU transfer. An extensive infectious workup, including lumbar puncture, was unrevealing and portions of her examination, namely agitated delirium with confusion, restlessness, and carphologia, were suggestive of an anticholinergic toxidrome.
Intubation was considered, however, in an attempt to stave this off she was given 20 mg of diazepam followed by 1.5 mg physostigmine which led to complete resolution of her delirium. At this time she provided a clear history of her overdose. Over the next 24 hours she received a total of 20.5 mg of physostigmine (given in 13 bolus doses) for anticholinergic delirium when it would intermittently occur, with periodic bolus doses of diazepam given for presumed concomitant benzodiazepine withdrawal. There were no complications.
Discussion: Quetiapine and its active metabolite can cause delayed anticholinergic toxicity via the formation of an active metabolite, N-desalkyl quetiapine, which has a half-life of 12 hours, nearly double that of the parent compound. Physostigmine is the treatment of choice for anticholinergic delirium but carries a small risk of seizures. In our case, we were initially hesitant to give physostigmine in the setting of benzodiazepine withdrawal. She was ultimately pretreated with diazepam and her anticholinergic delirium improved dramatically with physostigmine. There were no complications from the repeated doses or large cumulative dose of physostigmine despite the presence of benzodiazepine withdrawal and a presumed decreased seizure threshold. Previous studies have suggested pre-treatment with benzodiazepines lowers the seizure risk from physostigmine; this case is consistent with that literature.
Conclusions: Quetiapine toxicity can result in prolonged anticholinergic toxicity due to presence of a long-acting active metabolite and may require repeated doses of physostigmine for management of agitated delirium. Physostigmine was safely administered after pre-treatment with diazepam in the setting of benzodiazepine withdrawal.

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173. Envenomation by *Androctonus amoreuxi* (Egyptian Yellow Fat Tail scorpion)

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Background: Scorpion envenomations are not uncommon among scorpion hobbyists. The genus *Androctonus* is particularly deadly and a major cause of scorpion envenomation morbidity and mortality worldwide. We report a case of envenomation by an Egyptian Yellow Fat Tail (*Androctonus amoreuxi*) scorpion and the subsequent clinical course.
Case report: A 47-year old otherwise healthy man and dangerous scorpion collector, presented to the Emergency Department (ED) after having been stung on his right middle finger while hand-feeding his pet *Androctonus amoreuxi*. Within one hour he developed pain at the site, local edema, and severe paresthesias of the right arm. This was quickly followed by crampy abdominal pain and a throbbing headache.
Upon arrival to the ED his vitals were: temperature 38 celsius, heart rate 120 beats per minute, blood pressure 170/90 mmHg, respiratory rate 24, and oxygen saturation 98% on room air. Laboratory studies were notable for a WBC 11.0 k/uL, bicarbonate 21 mEq/L, lactate 2.9 mEq/L, creatinine 1.35 mg/dL (1.0 one year

prior), pH 7.54, and pCO2 27mm Hg. His EKG showed sinus tachycardia with normal intervals. His other labs were normal or unremarkable.
Over the next few hours he became progressively anxious and restless, developed nausea, and the paresthesias spread to his face and extremities, which he described as "fire hot skin embedded with shards of glass". He later developed dyspnea, severe myalgias, and intermittent diplopia.
His symptoms peaked around 18 hours post-envenomation, however, he remained hemodynamically stable throughout his stay and his laboratory studies quickly normalized. He never developed hypoxia or evidence of pulmonary edema. His transthoracic echocardiogram was normal. Ultimately he was discharged on HD3 with some mild abdominal and lingering paresthesias.
Discussion: *Androctonus amoreuxi* is one of multiple scorpions of the genus *Androctonus* that are found throughout North Africa and the Middle East. Scorpions from this area of the world account for 42% of the global sting burden and approximately half the fatalities. *Androctonus* venom contains a complex milieu of toxins which include neurotoxins, cardiotoxins, and immunoinflammatory peptides. The most clinically significant of these, an alpha-toxin, is a sodium channel opener. Envenomation most often causes localized symptoms that resolve with symptomatic and supportive care, however, they occasionally cause nonspecific life-threatening systemic symptoms from massive catecholamine release, autonomic hyperactivity, and cytokine release. Morbidity and mortality associated with *Androctonus* envenomations usually results from acute pulmonary edema and is often treated with a dobutamine infusion. Antivenom is available in the Middle East but its clinical efficacy is debatable.
In our case, the patient developed both local and systemic symptoms but never developed any signs of cardiopulmonary compromise. He didn't need dobutamine or receive antivenom and improved with symptomatic care alone.
Conclusion: *Andoctronus* envenomations are uncommon in the US but can be seen in scorpion hobbyists. These envenomations have a high morbidity and mortality as a result of acute pulmonary edema.

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174. Unregulated, naturopathic treatments in the era of COVID-19: a case of distributive shock after intravenous pyridoxine and niacin treatment

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Background: During the COVID-19 pandemic there has been an increase in unapproved therapies to treat, prevent transmission, and improve long-term effects from COVID-19 infections. Herein we present a case in which a patient self-administered an intravenous (IV) formulation of a product obtained from a foreign country and required hospitalization from its unintended complications.
Case report: A 44-year old female with no known allergies self-administered an IV bag of vitamins she obtained from Mexico to treat lingering fatigue and malaise from a recent COVID-19 infection. The IV bag was formulated in Mexico by a naturopathic practitioner and consisted of various vitamins, including "*Bedoyecta*", an unregulated formulation of B and C vitamins. Within 15 minutes of starting the infusion, she experienced severe nausea and vomiting, abdominal pain, lower extremity paresthesias and weakness, blurred vision, chest tightness, and dizziness. Over the next few hours she developed hyperemia, flushing, and diaphoresis culminating in a syncopal episode that prompted her friends to call 911.
ED vitals were: temperature 37.5 °C, pulse 110 beats/minute, blood pressure 90/50 mmHg, respiratory rate 24 breaths/minute, and SpO2 98%. On examination she had warm, flushed skin, mild diaphoresis, and angioedema of the face, lips, chest, and abdomen. Laboratory studies are shown in . Electrocardiogram and imaging were normal. Bedside cardiac ultrasound showed grossly normal LV function. She was started on IV fluids, norepinephrine up to 0.25 ug/kg/hour, and antibiotics for presumed distributive shock. She was given IV diphenhydramine, dexamethasone, and ranitidine for possible anaphylaxis, with no appreciable effect.
Over the next 24 hours her hemodynamics improved and she was weaned off vasopressors. Her WBC peaked at 60 k/uL and an extensive infectious workup was unrevealing. She never developed a fever, hypoxia, airway compromise, or pulmonary symptoms. Renal insufficiency precluded administration of NSAIDs, the treatment of choice for systemic niacin toxicity. She was discharged without complications after a four day hospitalization.
Discussion: Toxicity from IV niacin and pyridoxine is rare and the literature is scant. In our case, the patient quickly developed GI and peripheral neurologic symptoms followed by the delayed development of hyperemia and distributive shock, with laboratory evidence of a profound, transient leukocytosis and elevated inflammatory markers. These two phases of illness correspond to the sequential toxicity of IV pyridoxine and niacin toxicity respectively that are reported in the literature. While endotoxemia from bacterial decontamination and anaphylaxis would present similarly, the absence of fever, pulmonary symptoms, and airway compromise and minimal response to anaphylaxis treatments argue against this. Niacin and pyridoxine are quickly metabolized and cleared from the body and we were unable to obtain accurate serum levels of niacin and pyridoxine from admission labs because the specimens were not immediately light protected.
Conclusions: Toxicity from IV pyridoxine and niacin is rare and presents with peripheral neurological symptoms followed by the delayed development of hyperemia and distributive shock respectively. Providers should be cautious of toxicity from self-treatment of unregulated products, particularly in the COVID-19 pandemic.

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175. Ramp mimic misadventure leading to detectable digoxin concentrations in three patients

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Background: Wild leeks (*Allium porrum*), also known as ramps, are an edible plant known for their strong garlic-like odor and onion flavor. Because of this, ramps are often a coveted item by plant foragers. Unfortunately, ramp mimics like Lily of the Valley (*Convallaria majalis*) and False Hellebore (*Veratrum viride)* can lead to foraging errors and subsequent patient harm/toxicity. We

describe three adults who foraged and ate what they believed were ramps, and then subsequently became symptomatic with detectable digoxin concentrations.
Case report: A 41-year-old woman, 41-year-old man, and a 31-year-old man, each with no significant past medical history, presented to the emergency department 1.5 hours after ingesting an unknown plant. Earlier that day, the youngest in the group went into their backyard and identified what he believed to be *Allium porrum*. The plant was harvested and included as an ingredient in tacos. Thirty minutes after ingesting the tacos, all three patients began complaining of an abnormal sensation in their throat, and two patients began vomiting. On arrival to the emergency department, all three patients were hypotensive and bradycardic, the lowest being the 41-year-old woman who had a blood pressure of 81/43 mm Hg, with a heart rate of 44/minute.
All three patients received intravenous fluids in addition to activated charcoal. Initial laboratory studies about 4 hours after ingestion were notable for detectable digoxin concentrations of 0.08 ng/mL, 0.09 ng/mL, and 0.13 ng/mL with paired potassium concentrations of 3.6mEq/L, 3.8mEq/L. and 3.1mEq/L. One patient received 20 vials (800mg) of digoxin antibody fragments for hypotension and bradycardia with subsequent improvement in HR and BP. Aside from sinus bradycardia, no electrocardiographic changes were observed. All three patients were admitted overnight and recovered the next day without complication. Approximately 12 hours after ingestion blood was negative for digoxin in two patients and 1.3 ng/mL in the patient treated with digoxin specific Fab.
Discussion: Wild leek misadventures can be a source of morbidity given their similarity in appearance to plants like Lily of the Valley and False Hellebore, both of which can cause gastrointestinal symptoms and detectable digoxin concentrations. Lily of the Valley causes a detectable digoxin concentration via its cardiac steroid compound (convallatoxin) that is similar to digoxin. False Hellebore, although not containing cardiac steroids, contains alkaloid compounds that can cross react with digoxin assays and lead to a falsely elevated digoxin concentration.
Conclusion: Clinicians should be prompted to think about ingestion of Lily of the Valley and False Hellebore when patients present with bradycardia, gastrointestinal symptoms, and detectable digoxin concentrations after plant ingestion and/or ramp foraging.

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176. A "berry" tricky stroke mimic - a case series of four patients who ingested susumber berry

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Background: Stroke mimics are of particular concern to clinicians because misdiagnosis leads to unnecessary testing, increased healthcare costs, and potential patient harm from radiation (computed tomography scans) or medication administration (tissue plasminogen activator). Although common stroke mimics include etiologies such as migraine, peripheral vertigo, and Bell's palsy, toxicologic etiologies of stroke mimics are less common. We describe a series of four patients who presented with signs and symptoms concerning for acute strokes after ingestion of susumber berries (*Solanum torvum)*.
Case report: Patient A is a 72-year-old woman who presented to the Emergency Department (ED) with dizziness, dysarthria, impared swallowing, left-beating nystagmus, left upper extremity weakness, and ataxia. She underwent computed tomography imaging (CT), CT-Angiography, and magnetic resonance imaging (MRI) testing which demonstrated no localizing lesion and she was admitted to the hospital for further investigation. Six hours later, Patient B(sister of Patient A) presented to the hospital with dizziness, dysarthria, and ataxia. She underwent identical brain imaging which was equally unrevealing. Both patients developed rhabdomyolysis without identifiable precipitants. Upon discovery of the patients' relationship, the primary team learned that the patients shared a meal of susumber berries imported from Jamaica on the evening prior to presentation. Both patients experienced complete resolution of symptoms, normalization of Creatine kinase levels, and were discharged home.
Patients C and D are a 48-year-old-man and his 69-year-old mother, respectively, who presented roughly twelve hours after eating susumber berries. The man, who presented to the ED first, was activated as a stroke code given his symptoms of slurred speech and weakness, and physical examination was significant for opsoclonus, difficulty ambulating, and finger-to-nose dysmetria. The mother, who presented shortly after her son, complained of weakness and blurry vision, and her physical examination was notable for globally decreased motor strength. Both patients were admitted to the hospital and were discharged home 24 hours later following complete symptom resolution.
Discussion: Susumber berries (*Solanum torvum*) are a polyonymous component of several cuisines, variously referred to as "susumba," "gulla beans," or "turkey berries." In the United States, they are most recognized as a component of Jamaican cooking, often served with saltfish or rice. Solanum torvum contains steroidal glycoalkaloids that cause both gastrointestinal symptoms and neurological symptoms, the latter of which are of particular concern due to their ability to mimic an acute stroke. Prior cases show patients experiencing symptoms such as ataxia, blurred vision, slurred speech, facial paralysis, numbness, weakness, and altered mental status. As demonstrated in our cases above, when patients develop neurotoxicity from susumber berry ingestion, they may receive extensive and unnecessary medical evaluation in the pursuit of an erroneous stroke diagnosis.
Conclusion: While a comprehensive dietary history is challenging to obtain in the harried setting of early evaluation of acute neurologic deficits, a constellation of deficits that fail to localize to a single lesion should prompt consideration of toxicologic etiology. A thorough toxicologic history may reveal such culprit ingestions as the deceptive and idiosyncratic *Solanum torvum*.

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177. Fatal attraction: the dangers of online marketing of weight loss supplements

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Background: Dinitrophenol (DNP) was used as a fabric and food dye and in pesticides. DNP was one of the earliest attempts at a pharmaceutical treatment for obesity popularized in the 1930s as a weight loss agent. It was banned in 1938 after reports of adverse outcomes including death and commercial use in US agriculture ended in 1998. In 2002 there was a resurgence of use following online marketing to bodybuilders as a weight loss

supplement. The FDA ban was reissued in 2003 noting DNP was "extremely dangerous and not fit for human consumption".
Case report: 51 year old female with a previous DNP overdose was found unconscious by law enforcement during wellness check having last been seen normal 12 hour prior. She was transported to the Emergency Department (ED) where her vital signs were BP 146/80, HR 124, RR 27, 96% on non-rebreather, oral temp 98.3 (F). Ocular clonus was noted and she was unresponsive to nocuous stimuli. A core temperature was measured 12 minutes after arrival at 105 (F). External cooling was initiated. Labs showed Lactate 5.7, Na 152, AG 22. The EKG showed sinus tachycardia. PR and QRS intervals were normal and prolongation of the QTc to 589 msec. T wave inversions were present. IVF and sodium bicarbonate were started for presumed acidosis, cooling with ice packs and cooling blankets was initiated, however, the core temperature increased to 110 (F). The patient was intubated and sedated with midazolam, then developed PEA and was given atropine and epinephrine with ROSC. Ventricular Tachycardia developed and amiodarone and magnesium were administered, then she became hypotensive and norepinephrine was added to the IVF. The patient had another PEA arrest but recovered with CPR followed again by PEA and ultimately asystole. CPR continued for 20 minutes with multiple doses of epinephrine, an amp of sodium bicarbonate and calcium. The patient was pronounced dead 1 hour after arrival in the ED.
Discussion: DNP uncouples oxidative phosphorylation leading to loss of energy as heat instead of being converted to ATP resulting in failure of thermoregulatory homeostasis and profound hyperthermia. Patients display sweating, tachypnea, tachycardia, and fever as early as 3 hours from overdose. Many websites advertise a therapeutic DNP dose as 5-8 mg/kg daily, which is approximately $^1/_3$ of the estimated lethal dose of 20-50 mg/kg suggesting a narrow therapeutic index. Due to its long half-life (5-14 days), accumulation of DNP in the body can occur easily, leading to toxicity with chronic consumption. Large volume of distribution and mostly intracellular action limits treatment options, as hemodialysis and hemoperfusion are ineffective. Care should emphasis rapid cooling, maintaining airway, and replacement of insensible fluid loss from diaphoresis and fever.
Conclusion: This DNP fatality highlights the risks to public health stemming from online availability and use despite its ban in 1938. While uncommon, healthcare workers should be aware of the toxicity and presentation of acute and chronic DNP toxicity, as onset and decline is rapid and potentially fatal after overdose.

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178. Compartment syndrome and rattlesnake envenomation: a review of the NASBR subregistry 2013-2020

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Background: Compartment syndrome (CS) after North American Rattlesnake envenomation (RSE) is rare, often misdiagnosed and frequently mismanaged. Standard of care is to check intracompartmental pressures (ICPs) prior to performing fasciotomies after RSE, and antivenom (AV) is the first line treatment for suspected CS. Rate of adherence to these standard practices amongst physicians caring for patients with RSE is not well documented. Data describing incidence of CS and risk factors for its development after RSE is also limited.
Methods: This is a review of prospectively collected data from the North American Snakebite Registry (NASBR), a Subregistry of the Toxicology Investigators Consortium (ToxIC) Registry. Inclusion criteria were cases in which there was a documented concern for CS entered into the Registry between January 1, 2013 and December 31, 2020. Data collected included demographics, clinical envenomation features, management, and outcome.
Results: Over 8 years, 20 cases (1.4% of NASBR cases) of possible compartment syndrome were reported in 10 US states. Arizona was the most common location (N = 8, 40%). Snake species included 13 Rattlesnakes, 6 Copperheads, and 1 unknown pit viper. Median age was 34 years (range 2-59); 17 (85%) were male. 14 (70%) envenomations occurred in upper extremities, most commonly on the hand (N = 7, 50%). Median time from bite to first antivenom administration was 2.25 hours (IQR 1.7-4.3). Time from bite to health care presentation was 1 hour (IQR 0.65-1). Crofab® was administered in all cases; one case received both Crofab® and Anavip®. Median total vials AV was 19 (IQR 10-25). Loss of mobility in hand or foot was reported in 7 (35%) of cases. ICPs were obtained in only 5 cases (25%) in which compartment syndrome was suspected. In one case the ICP was low (8 mm Hg), and fasciotomy was avoided.
There were 8 fasciotomies performed (0.6% of NASBR cases). Compartment pressures were only measured in 4 (50%) of these cases. 5 (63%) were in upper extremities. Snake type was predominantly Rattlesnake (7, 88%) In these cases, median time to presentation was 1.25 hours (IQR 0.9-2); time to AV was 3.25 hours (IQR 2.3-4.3). Median number of vials of AV was 19 (IQR 16-22).
Conclusions: Suspected cases of CS were rare in the NASBR Subregistry. When CS was suspected, ICP measurements were rarely performed. Despite the fact that it is standard of care to obtain ICPs prior to fasciotomy in cases of RSE, half of fasciotomies were performed without ICP measurements. Educational efforts regarding best practices in the management of suspected CS after RSE may be needed.

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179. Medical cannabis use in cancer patients presenting to the emergency department with acute pain

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Background: As of 2021, medical cannabis (MC) in the United States is approved for adult use in 36 states and 4 territories, and recreational cannabis is approved in 17 states, two territories and the District of Columbia. With increased uptake of MC, adverse events, toxicity and drug-drug interactions occur more frequently and may be evaluated by toxicologists through emergency department consults or poison center calls.[1] For nearly every state, cancer and its associated symptoms (e.g. pain), are indications for MC recommendation, yet access and use of MC,

whether recommended or recreational is less defined. Most oncologists view cannabis as helpful for cancer related symptoms, but only 30% feel informed enough to make recommendations to patients.[2] Patients therefore may be using cannabis for medical purposes but obtaining information guiding their use from non-medical sources.[3] We sought to evaluate the characteristics of MC use among cancer patients in the emergency department (ED) with acute pain.

Methods: We conducted a cohort study of ED patients with cancer who presented to our urban, academic tertiary care ED with a complaint of acute pain. Eligible participants were recruited to complete a self-administered quantitative survey on REDCap containing questions surrounding their pain, opioid, non-opioid analgesic use including cannabis. The cannabis module contained questions around use, access to MC, route of use and source of recommendation. The survey also explored patient discussion about cannabis with their oncologist and medical team.

Results: During the study period, 144 participants completed the survey; 13 participants (9%) reported using cannabis for pain. Four were female and 3 were male. Ten patients were White, 2 were Asian, 1 was African American and the mean age was 41. Seven patients (53.8%) of patients reported incurable or metastatic disease. Of participants, 5 used medical cannabis, 4 used recreational cannabis, and four reported THC/CBD formulations for their pain. Participants most commonly reported oral ingestion (76.9%;n = 10), followed by smoking (30.8%;n = 4), vaping (15.4%;n = 2), and transdermal application (7.7%;n = 1). Most participants were likely to have discussed their cannabis use with their oncologist (76.9%;n = 10), and the majority indicated that their oncologist approved of their use. Information about cannabis came primarily from friends and family (69.2%;n = 9) or dispensaries (46.2 %;n = 6) instead of their medical team (23.1%;n = 3) or the medical certifier recommending cannabis (7.7%;n = 1).

Conclusions: Cancer patients are self-administering medical and recreational cannabis using the oral route to address pain. While 75% of participants divulged their use of MC to their oncologist, information around actual use was mostly obtained through friends and family or dispensaries. While a small sample self-reported the use of MC, most described oral administration. In the setting of multiple medical comorbidities and experimental chemotherapeutics, cannabis toxicity and adverse drug events including drug interactions may be underrecognized in this population. Careful query of cancer patients with acute pain in the ED should also surround the use of MC, type of cannabis used and its potential interaction with other prescription medications

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180. Bites by pet arachnids - epidemiology of cases reported to the Swiss National Poisons Information Centre over a period of 44 years

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Background: The keeping of arachnids is a popular hobby worldwide. In Switzerland it is regulated in only one city. Theraphosid spiders or scorpions are available in many pet shops or animal fairs, where they can easily be purchased. The aim of the present study is to characterize the epidemiologic and clinical features of bites by pet arachnids over a period of 44 years in Switzerland.

Methods: We included all calls regarding pet arachnids in Switzerland and Liechtenstein recorded at the Swiss National Poisons Information Centre (Tox Info Suisse) from January 1977 to December 2020. Inclusion criteria comprised at least the reported family of the animal and a clinical course, compatible with an arachnid bite or sting. Exclusion criteria were Swiss citizens bitten or stung abroad, calls from other countries than Switzerland and Liechtenstein and dermal or ocular exposures to hair of the animals.

Results: Within the study period, 1,130 calls related to arachnids were recorded at Tox Info Suisse. Of these, only 81 (7.2%) could be attributed to pet arachnids, with 56 spiders (69%) and 25 scorpions (31%). Of the 56 spiders 10 belonged to the genus of *Poecilotheria* and 10 to the genus of *Brachypelma sp*., respectively. Out of the 25 scorpions 4 each were attributed to *Hottentotta* and *Centruroides sp*., respectively. Out of 46 medical follow-up report, 20 cases (43%) exhibited a good causality (at least probable). In half of the episodes spiders and in the other half scorpions were involved, respectively. Only adult patients (> 16 years of ages) were affected, with a median age of 32 (range 19-65) for spider bites and 25 (range 16-70) for scorpion stings. In 14 episodes (70%, 7 each) males were affected. All patients were bitten or stung in the hand. Out of the 10 patients with spider bites, the main genera were *Poecilotheria sp*. with three, and *Brachypelma sp*. with two cases, respectively. Out of the 10 patients with scorpion stings, the main genera were *Androctonus sp*. and *Pandinus.sp,* with two cases each. The clinical course after spider bites was mild with pain and paresthesia in half of the patients (50%); or moderate in the other half (50%) with muscle cramps. 80% of the scorpion stings remained mild with pain, redness and swelling at the site of the sting. One patient experienced moderate symptoms with considerable pain, and one patient even severe pain with radiating symptoms requiring opioid therapy. There were no fatalities and no sequelae recorded within the study period.

Conclusions: The bites or sting of pet arachnids rarely resulted in medically important symptoms, and envenomation is a rare occurrence in Switzerland.

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181. Aconite tea: traditional remedy or public bane

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Background: *Aconitum* plant roots are used in herbal remedies for a wide variety of illnesses. These roots require specific preparation prior to safe human use. Therapeutic misadventures, accidental ingestions, and intentional ingestions have all been associated with significant toxicity. *Aconitum* species contain aconite and related alkaloids that act as cardiotoxins and neurotoxins through activation of voltage-gated sodium channels.

Case report: A 24-year-old female with recent history of COVID-19 and subsequent Bell's palsy presented to the emergency department (ED) with bilateral paresthesias, gastric distress, muscle cramps, jaw tremor, bradycardia, and hypotension. These symptoms had rapidly progressed over 3 hours after drinking

approximately 1 cup of a brewed tea consisting of scorpion 3g, aconite root 20g, and dried silk-worm 3g. This recipe was recommended to her by her mother to treat the Bell's palsy and prevent against COVID-19, and she was not sure she got the measurements correct. On arrival to the ED, she was bradycardic (46 bpm) and hypotensive (72/42 mmHg). ECG demonstrated significant ectopy with QRS 82 msec, QTc 474 msec, and greater than 50% PVCs. Comprehensive metabolic panel was within normal limits; acetaminophen, salicylate, and digoxin levels were undetectable; and urine drug screen was negative. CT demonstrated no intracranial abnormalities. Aconite and deoxyaconitine were confirmed by quadruple time-of-flight mass spectrometry. She received IV fluids, amiodarone 150mg IV bolus, norepinephrine infusion, and an admission to the ICU. Cardiovascular and neurological symptoms resolved after 1.5 days and she was discharged on hospital day 2.

Discussion: *Aconitum* has been used primarily in Asia to treat a variety of ailments including viral illnesses, hypertension, bronchitis, and pain. Despite insufficient evidence, *Aconitum* has now also been proposed as a treatment for COVID-19. The COVID-19 pandemic has disrupted access to primary care providers and has led to an increase in internet searches for, and usage of, alternative medicines. As a result, westernized countries that don't typically see aconite toxicity may see an increase in exposures. Therefore it is important for toxicologists, poison specialists, and emergency physicians alike to become more familiar with aconite toxicity. Within minutes of ingestion patients may experience diaphoresis, chills, and perioral/limb numbness, which can progress to gastric distress, bradycardia, hypotension, dysrhythmias, CNS depression, and seizures. Refractory ventricular dysrhythmias are the main cause of death. ECG changes seen with aconite poisoning can be similar to those seen with cardioactive steroid toxicity, so the presence of paresthesias can be useful to differentiate to two. The duration of severe toxicity is variable based on the case reports, but patients often required cardiovascular support and monitoring for approximately 24-48 hours. Treatment focuses on hemodynamic support, sodium channel blockade with amiodarone as a preferred antiarrhythmic agent, and general supportive care.

Conclusions: Our patient experienced severe aconite toxicity after ingesting an *Aconitum* tea. Her symptoms consisted of paresthesias, GI distress, bradycardia, hypotension, and dysrhythmias, which required pharmacologic support and admission to the ICU. Recent proclamations of *Aconitum* as a COVID-19 remedy and the increase use of alternative medicine may lead to more aconite exposures.

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182. Case report of suspected palytoxin fatality with negative postmortem blood and urine analysis

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Background: Palytoxin is a potent toxin which converts sodium-potassium ATPase pump into nonspecific ion channels leading to global cellular death. The incidence of palytoxin reported to US poison centers have increased from 2001-2017. We report a fatality case reported to the poison center secondary to suspect palytoxin.

Case report: 43-year-old man with a history of a heart murmur and diabetes mellitus was found unresponsive by his wife in bed with agonal breathing. His wife initiated bystander cardiopulmonary resuscitation. Paramedics found the patient in a shockable rhythm with defibrillation times one. Upon arrival to the emergency, patient was intubated and found to have atrial fibrillation with a rapid ventricular rate, QRS prolongation (146 ms), and QT_C prolongation (572 ms). Patient had intermittent ventricular fibrillation status post four additional rounds of defibrillations and was admitted to the intensive care unit (ICU) on 100% FiO_2, amiodarone, and lidocaine. Upon further history from his wife, patient was an amateur breeder of coral fish. During a winter storm, many of the fish and coral kept in the garage did not survive. The patient was cleaning out the aquarium in a closed garage prior to his cardiac event. Exact species of coral were unknown. In the ICU, patient was found to have acute respiratory distress syndrome without findings of COVID-19 or pulmonary embolism, acute kidney injury, and acute liver injury. Nine hours after presentation, patient sustained another pulseless ventricular fibrillation event, but he was not able to be resuscitated despite >30 defibrillation attempts and administration of lipid emulsion. On autopsy, patient had findings of hypertensive cardiovascular disease. Extensive panel of 910 new psychoactive substances, 161 drugs of abuse, 15 bioactive dietary supplements, and 92 prescription drugs revealed only medications he received therapeutically. Liquid chromatography-Quadrupole Time-of-Flight Mass Spectrometer analysis of palytoxin and metabolites in postmortem whole blood and urine samples did not detect any compounds. Unfortunately, samples of the coral were disposed of by hazmat and were not available for analysis.

Discussion: The patient's clinical presentation and historical context suggest exposure to palytoxin leading to his death. Palytoxin is produced by soft coral of the *Palythoa* and *Zoanthus* species but can also bioaccumulate in dinoflagellates, fish, and shellfish. Human exposure can occur through ingestion, inhalation, or cutaneous routes. Clinical effects of palytoxin are consistent with the patient's presentation. Given the nonspecific nature of interaction with the sodium-potassium ATPase pump, palytoxin can affect numerous organ systems including cardiovascular (dysrhythmias), central nervous system (seizures, numbness), gastrointestinal (nausea, vomiting, diarrhea), and pulmonary (dyspnea, respiratory failure). Analysis of palytoxin in biologic samples can be difficult because of the large molecular size (2680 Da), prevalence of analogs, and potency of toxicity (24-hour LD_{50} 0.089-0.63 mcg/kg in rats depending on exposure route). To date, no human exposure case reports has confirmed palytoxin in a clinical sample.

Conclusion: Exposure to palytoxin can be rapidly fatal with diagnosis largely reliant on historical and clinical context. Biologic analysis of palytoxin is difficult and may not reliably confirm exposure.

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183. A tale of two botulism cases

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Background: Infantile botulism is a rare, but serious disease resulting from ingestion of *Clostridium botulinum*. Approximately 150 cases are reported each year in the United States, primarily

in the West Coast and North East. We describe two cases of infantile botulism presenting within a 2-week period in a geographical area where botulism is infrequently reported.

Case series: A 2-month-old female presented to the ED after 5 days of constipation. Approximately 10 days prior to presentation, the patient was given raw honey for a cough. On physical exam, the patient was found to have ptosis, sluggish pupils, head lag, and decreased suction during feeding. Vitals and labs were unremarkable, and she was admitted to the ICU. Toxicology was consulted due to concern for botulism, and botulism immune globulin was ordered. On day 2, a stool sample was sent for testing and the patient received 275 mg of botulism immune globulin. Over the next several days, the patient slowly regained strength, improved feeding, and increased bowel movements. On day 8, she was discharged from the hospital without complications. On day 20, the botulism test on stool resulted positive.

A 1-month-old male presented to the ED after 1 day of lethargy and decreased feeding. The mother reported a gradual onset of less frequent stooling which worsened 1 week prior to presentation. Several weeks prior to presentation, the family tilled their home garden. The patient was administered homemade maple syrup and store-bought aloe vera for constipation. Initial imaging and lab workup were unremarkable. On day 2, toxicology was consulted due to concern for botulism. Physical exam was significant for ptosis, mydriasis, and decreased sucking. Further work up was completed which showed a respiratory virus panel positive for rhinovirus/enterovirus. Later in the evening, the patient became hypoxemic requiring intubation. On day 3, a stool sample was collected, and botulism immune globulin 250 mg was administered intravenously. The patient remained intubated and sedated on dexmedetomidine. He was briefly extubated on day 6 but required reintubation for respiratory support on day 7. The patient slowly improved and was extubated on hospital day 11. Preliminary testing on stool was positive for botulinum A toxin on day 12. The aloe vera and maple syrup tested negative for botulinum toxin, leaving the garden soil as the suspected source. The patient continued to slowly improve and was discharged without complications on day 17.

Discussion: Honey and soil have both been well described sources for *C. botulinum*. Over a recent 10-year period, only 3 confirmed cases of infantile botulism were reported in our state. Botulism was confirmed in both cases, which is remarkable given the rarity of the disease in our geographical region.

Conclusion: We present two cases of confirmed infantile botulism requiring antidotal therapy who presented within a 2-week period in a geographical area where botulism is uncommon.

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184. A descriptive case series of a single poison center's experience of *Gyromitra* spp. ingestions over a 19-year period.

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Background: *Gyromitra esculenta*, known as the 'false morel', is a toxic mushroom commonly found in the spring season in Europe and North America. Many consider *Gyromitra esculenta* edible with inexperienced mushroom foragers often mistaking these for *Morchella esculenta* or 'true morels'. European cases report significant morbidity and mortality, including seizures and hepatotoxicity, secondary to ingestion of these mushrooms. However, North American reports have described a less severe toxidrome following ingestion of *Gyromitra esculenta*. Our objective was to conduct a longitudinal descriptive review of ingestions of *Gyromitra esculenta*, and related *Gyromitra* species that are known or suspected to contain gyromitrin, reported to our poison center in the Great Lakes region from 2002 to 2020.

Methods: A retrospective review of ingestions of *Gyromitra esculenta*, and related *Gyromitra* species known or suspected to contain gyromitrin, reported to a single poison center. We queried our poison center database for all cases involving *Gyromitra spp.* ingestions from January 1, 2002 to December 31, 2020. Inclusion criteria involved all human ingestions of *Gyromitra spp.* mushrooms known or suspected to contain gyromitrin; all ages and both sexes were included. Exclusion criteria included ingestions involving mushroom species other than *Gyromitra* species, non-human ingestions, and information request calls. Hepatotoxicity was defined as an elevated AST or ALT 2x the upper normal limit, with or without an INR $\geq$2. Neurotoxicity was classified according to symptoms including dizziness, headache, drowsiness, sedation, ataxia, tremor, hallucinations, agitation, confusion, delirium, and seizure.

Results: A total of 133 cases met inclusion criteria. The majority of subjects (78; 59%) were males. The median age was 57 years. Gastrointestinal symptoms were most frequent, including vomiting (45 cases; 34%), nausea (36; 27%), abdominal pain (24;18%), and hepatoxicity (13;10%). Four cases involved patients with an AST and ALT exceeding 1000 IU/L (3%). Hemolysis occurred in one case (0.8%). Neurotoxicity was present in 22 cases (17%), with headache (6; 4.5%) and dizziness (5; 4%) being the most frequently occurring symptoms. No seizures were reported.

Intravenous fluids, activated charcoal, cathartics, and antiemetics were the most common therapeutic interventions (65 cases; 49%), followed by N-acetylcysteine (8; 6%), and pyridoxine (7; 5%). Minor medical outcomes were most common (51 cases; 38%), followed by moderate (31; 23%), cases with no clinical/toxic effects (37; 28%), major (3; 2%), and cases with unknown outcomes (11; 8%). No deaths were reported.

Conclusions: The primary toxin in *Gyromitra esculenta* and other related *Gyromitra* species is gyromitrin, a volatile and unstable compound that is hydrolyzed to monomethylhydrazine. This metabolite is considered responsible for the neurotoxic effects by interfering with pyridoxal phosphate-related enzyme reactions which inhibit gamma-aminobutyric acid (GABA) synthesis.

Ingestions involving *Gyromitra esculenta* and related *Gyromitra* species, can cause significant toxicity. Classical teaching and previous literature more commonly describe neurological symptoms, including seizures. However, our 19-year review of *Gyromitra spp.* mushroom exposures demonstrated minimal neurotoxic symptoms and no documented seizures. The majority of patients manifested gastrointestinal symptoms, including hepatotoxicity. This may reflect geographic- and species-specific differences in clinical toxicity associated with *Gyromitra spp.* exposures.

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185. Confirmed grayanotoxin poisoning from a gift of imported honey

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Background: Human grayanotoxin poisoning is distinctly uncommon in North America, as the predominant source of human exposure is honey made by bees pollinating dense crops of Rhododendron species in the Mediterranean. Here we present a case of confirmed unintentional grayanotoxin poisoning from exposure to honey imported from Turkey.
Case report: A 61-year-old man with a history of hypertension abruptly developed nausea, followed by lightheadedness and loss of consciousness. He remained unresponsive to his family's attempts to rouse him for approximately 10 minutes. On EMS arrival, he was noted to be bradycardic to 40 beats/min, hypotensive to 72/40 mmHg, and remained unresponsive. He was treated with 0.5mg atropine IV, 900 mL of 0.9% NS, and O2 via NRB, at which point his heart rate and blood pressure improved. He regained consciousness within minutes of treatment.
On waking, he reported that he had an "identical" episode 3 days prior to presentation, for which he was admitted to the hospital for 2 days. Evaluation at that time, which included a normal echocardiogram, did not reveal an etiology. Both episodes, he now noted, occurred approximately 30 minutes after ingestion of honey that was brought to the United States from Turkey and given to him as a gift, first dissolved in soup and subsequently spread on toast. He was admitted again to the hospital, underwent repeat echocardiogram, telemetric monitoring, and complete laboratory studies including a metabolic panel, blood count, troponin, and a urine drug screen, all of which were unremarkable. His symptoms did not recur, and he was discharged to home.
The patients, blood, urine, and a sample of the honey were subsequently analyzed via liquid chromatography–mass spectrometry, and revealed the presence of Grayanotoxin I and Grayanotoxin III in each of the samples.
Discussion: Grayanotoxins are a group of related diterpenoids found in Rhododendron species, especially Rhododendron ponticum, as well as several other species in the Ericaceae family. Their pathologic effects are most notable on sodium channels. Grayanotoxin I, in particular, increases the flow of sodium and calcium ions across membranes. Clinical effects span multiple organ systems including gastrointestinal (nausea, emesis, diarrhea), cardiac (bradycardia, heart block, dysrhythmia, hypotension), and neurologic (seizures). Treatment is largely supportive, and a good response to atropine and IV fluids has been previously described.
While laboratory confirmation of grayanotoxins in biological specimens or residual ingested material is generally not available in a short enough turnaround-time to be clinically useful during immediate management, confirmatory testing may obviate the need for further outpatient evaluation to pursue alternative etiologies, as in this case.
Conclusion: Grayanotoxin is likely to remain a rare source of poisoning in North America, but as consumer quantities of goods and produce continue to easily cross international borders, occasional exposures can be expected to continue. Recurrent symptomatic bradycardia without alternative etiology should prompt a thorough exposure history, which may be revealing, as in this case, of a treatable toxicologic etiology.

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186. Early experience with Fab2 antivenom to treat Arizona rattlesnake envenomations

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Background: Crotalidae immune $F(ab')_2$ antivenom (Fab2AV) became available for treatment of rattlesnake envenomation (RSE) in the United States in 2019. Clinical experience and patient outcomes data associated with use of Fab2AV are limited.
Methods: This is a retrospective study of all patients presenting with RSE to two urban referral centers between Jan 2019 and Dec 2020. Patients treated with Fab2AV were included; patients who received any other antivenom or no antivenom were excluded. Data collected included patient demographics, clinical and laboratory findings, treatment, hospital length of stay (LOS) and outcomes. Descriptive statistics were used to report results. Definitions: thrombocytopenia = platelets $\leq$120 K/mm^3, coagulopathy = fibrinogen $\leq$170 mg/dL, late hemotoxicity = new or worsening thrombocytopenia or coagulopathy after treatment and during follow up. The study was approved by each facility's IRB.
Results: 46 patients were included, with a male/female distribution of 70%/30%. 54% of bites were to the lower, and 46% to the upper extremity. Findings included: extremity swelling in 100%, 13 with superficial tissue necrosis, hypotension responsive to fluids in one patient, neurotoxicity in one patient (resolved after receiving Fab2AV), and no major bleeding events. Thrombocytopenia and coagulopathy were present in 20% and 35%, respectively. Median time to 1st dose of Fab2AV =3.0 hrs (IQR 2-6) and the median total dose administered was 20 vials (IQR 14-26). There were 3 mild acute hypersensitivity reactions, each treated, and in 2 of 3 the Fab2AV was continued. Median LOS was 1.6 days (IQR 1-2.6). 89% of patients had at least one set of follow up labs obtained after discharge. 83% had follow up at least 5 days after discharge, and 53% had follow up at least 7 days after discharge. In the follow up period, there was one case of delayed thrombocytopenia (platelets nadir =108 K/mm^3), one case of recurrent thrombocytopenia (platelets nadir =111 K/mm^3) and no late coagulopathy. 4 patients reported a rash in the follow up period, suspected to be serum sickness. There were no readmissions or retreatments.
Conclusion: Patients treated for RSE in Arizona received a median dose of 20 vials Fab2AV and experienced a hospital LOS under 2 days. Fab2AV was associated with 6.5% early and 8.7% late hypersensitivity reactions, all mild in this series. Although thrombocytopenia was noted in two cases in the follow up period, there were no clinically significant cases of late hemotoxicity and no bleeding.

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187. Validation of a plant identification application for identification of digital images of toxic plants

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Background: Plants accounted for over 45,000 exposures in humans reported to American Poison Control Centers in 2019, making it one of the top 25 most reported categories. Eleven percent of these exposures are due to an unknown plant. Several plant identification applications now exist to aid in identification based on machine learning. A previous study compared three

different commercially available applications and identified PictureThis as the most accurate when identifying toxic plants; however, this study was small and out of the 17 species of plants tested, PictureThis identified 10 species correctly. This study aims to validate PictureThis on a larger, more diverse, collection of toxic plants.
Methods: Pictures of poisonous and injurious plants were obtained from a digitalized textbook and were analyzed using the unpaid version of PictureThis on an iPhone 11 Pro. If there was more than one photo for a particular plant species, all photos were analyzed. One attempt was used for identification of each picture. Pictures that did not contain plants were excluded (for example, pictures of jewelry made from plant parts or seeds). Given that often poison control centers and toxicologists must rely upon digital photographs of plants sent in from patients rather than the actual plant, digitalized photos of plants were thought to be representative of real-world conditions.
Results: 364 photos were analyzed which included 162 individual plant genera and 232 individual plant species. Of the 364 photos used for analysis, PictureThis correctly identified both the genus and species in 64% (n = 233). However, the correct genus was able to be identified in 81% (n = 296). The plant identity including genus was incorrectly identified in 68 photos which included 36 different genera after accounting for genera with multiple photos. This included several highly toxic plant genera including *Blighia, Conium, Datura, Pieris, Strychnos* and *Urginea*. For the 101 plant species with multiple photos available for analysis, PictureThis obtained the same result, either correct or incorrect, consistently in 81% (n = 82).
Conclusions: PictureThis had over 80% accuracy for identifying a wide variety of digital images of toxic plants by genus, however performed only at 64% for specific species. This is similar to prior work by Otter et. al., which demonstrated a 59% accuracy for plant species. Often consultation with a botanist is not available in real time at regional poison control centers. Knowledge of plant genus is useful even without knowing the specific species, therefore this application is a useful adjunct for the medical toxicologist with appropriate clinical correlation.

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188. Infant botulism complicated by hyponatremia and subclinical seizures

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Background: Infant botulism is a rare disease caused by ingestion of *Clostridium botulinum* spores, which germinate in the immature infantile digestive tract and release botulinum toxin. Botulinum toxin is a neurotoxin and causes the disease's classic signs and symptoms, including poor feeding, lethargy, and paralysis. Seizures are not typically described. In fact, botulinum toxin has been explored as a treatment for epilepsy. Rare reports describe an association with syndrome of inappropriate antidiuretic hormone (SIADH) and hyponatremia. Here, we report a case of infant botulism that was complicated by seizures on electroencephalography (EEG) secondary to hyponatremia from SIADH.
Case report: A 3-month-old previously healthy, full-term female presented to the emergency department with decreased appetite and a change in activity over the past three days. She was born via cesarean section with no prior medical history. She was exclusively breast fed without exposure to honey. Her home was supplied by municipal water. There was recent construction in her neighborhood. In the emergency department, vital signs were: BP, 116/62 mmHg; HR, 170 beats/min; RR, 35/min; oximetry, 95% on 4 L O_2 via nasal cannula; temperature, 36.6 °C. Her exam was notable for 6 mm dilated but reactive pupils, intercostal muscle retractions, and lethargy. On hospital day 2, she had hypercapnic respiratory failure requiring intubation. An extensive workup, including MRI/MRV brain, lumbar puncture, and EEG, was unrevealing. On hospital day 3, toxicology was consulted, and an empiric diagnosis of infant botulism was made. She received botulinum immune globulin on hospital day 4. Her hospital course was complicated by hyponatremia on hospital day 5 with a sodium concentration of 128 mEq/L, during which time she had three subclinical seizures on EEG. After initiation of levetiracetam and improvement in sodium, no further seizures occurred. She was successfully extubated on hospital day 15 and regained bowel function on hospital day 18.
Discussion: Infant botulism is uncommon, but data from Centers for Disease Control and Prevention and the National Poison Data System suggests that the incidence is increasing. Botulinum toxin is a neurotoxin which prevents release of acetylcholine presynaptically. This leads to a descending paralysis. Botulinum toxin is being investigated as a treatment for epilepsy in animal models and is not typically associated with seizures. However, botulism has been described to cause SIADH and seizures can occur from hyponatremia. This patient's seizures correlated with a change in serum sodium concentration, and were thought to be due to hyponatremia. They resolved with levetiracetam and correction of sodium.
Conclusion: Seizures are rarely reported with botulism and when present are usually secondary to hyponatremia. Seizures may be underreported as patients with infant botulism are often paralyzed and sedated on mechanical ventilation.

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189. Cardiac glycoside and flavonoid toxicity from over-the-counter weight loss supplements: missteps in identification and management

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Background: Natural substances marketed as herbal weight-loss supplements are widely available in health food stores and pharmacies, and are often perceived as safe; however, there is limited evidence to support efficacy and their safety is untested. Despite this, an estimated 15% of adults have used a weight-loss supplement. Their widespread availability makes them a risk for accidental pediatric ingestion and off-target toxicities in adults. Yellow oleander (under multiple pseudonyms) and "raíz de tejocote" are two natural substances available for over-the-counter purchase for weight loss which have been associated with falsely-detected digoxin concentrations and symptoms of cardiac glycoside toxicity.
Case series: We report two distinct presentations of weight loss supplement ingestion with symptoms of cardiac glycoside toxicity and falsely-detected digoxin concentrations. The patients differed in age (18 months to 33 years), gender (male and female) as well as intent of ingestion (exploratory vs purposeful for weight loss). Both patients were previously healthy and used no medications or supplements, except for hypothyroidism treated with levothyroxine in the adult female patient. Reported supplements ingested included "raíz de tejocote" and "semilla de Brazil."
Patients experienced symptoms including abdominal pain,

nausea, vomiting, diarrhea, weakness. Vital signs ranged from normal, to bradycardic and hypotensive. Electrocardiogram (ECG) changes varied from sinus with junctional escape beats and borderline prolonged PR interval in the toddler to sinus rhythm with ST depression in leads II, III, aVF and V4-V6 in the adult female patient. Initial digoxin concentrations were abnormal in both patients at 1.0 ng/mL (Reference range 0.9-2.0 ng/mL) on Beckman DxC 700 AU and Beckman AU680 analyzers. Remaining labs were within normal limits and ELISA-based urine drug screens were negative. Both patients were admitted overnight for observation and supportive care. Vital signs and ECG changes resolved without administration of digoxin-specific antibody fragments.

Discussion: Yellow oleander, *Thevetia peruviana*, which has been sold under the specious name of "semilla de Brazil" contains numerous cardiac glycosides, which are known to cause falsely elevated digoxin concentrations and symptoms of cardiac glycoside toxicity. Similarly, "raíz de tejocote," Crataegus mexicana, a species of hawthorn, has recently been described to result in symptoms resembling cardiac glycoside toxicity and falsely elevated digoxin concentrations suggesting cross-reactivity with commercial digoxin assays. In both cases, the consulting providers interpreted the digoxin concentration as "normal" when the result fell within reference range. Finally, in the case of the adult, the primary team's internet search for "semilla de Brazil" resulted in information about the Brazil nut and selenium toxicity, leading to a delay in recognition of the true exposure and expected toxicities.

Conclusion: The safety of over-the-counter weight loss supplements cannot be guaranteed and consumers should be aware of potential toxicity when considering their use. Health care professionals should be aware that acute ingestions of these products present with cardiac glycoside toxicity, that confusion between scientific and common names and identities is a source of confusion, and that detectable serum digoxin concentrations are abnormal even if within laboratory reference range.

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190. Multiple organ failure in a child after ingesting seeds of *Colchicum autumnale*

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Background: Colchicine poisoning occurs most commonly secondary to the intentional or unintentional overdose of the pharmaceutical product. However, toxicity from plants containing colchicine alkaloids, such as *Colchicum sp.* and *Gloriosa sp.*, is also reported. *Colchicum sp.* is the more widely distributed of the two, containing more highly concentrated colchicine in the pods and seeds and less concentrated in the stalk and flowers. Colchicine inhibits mitotic function, affecting virtually all cells in the body, but initially most apparent on rapidly multiplying cells (such as the intestinal tract), leading to early and late phases of toxicity. The early phase is characterized by nausea, vomiting, and diarrhea, often leading to significant water loss and subsequent hypotension and electrolyte abnormalities. The more dangerous late phase may present with delirium, arrhythmias, renal failure, seizures, pulmonary edema, acidosis, coagulopathy, neuropathy, rhabdomyolysis, and pancytopenia/leukopenia; sepsis is a common cause of death secondary to leukopenia. Treatment of colchicine toxicity is largely supportive.

Case report: A previously healthy 4-year-old female presented to a Turkish emergency department with severe nausea, vomiting, diarrhea, and confusion 2 hours after ingesting an unknown number of seeds of a wild plant in her backyard. She initially presented with GCS 13 and vital signs significant for BP: 60/40 mmHg, HR: 150 bpm. Otherwise, physical exam was unremarkable. She was transferred to a pediatric ICU. Her initial labs were significant for LDH 4000 IU/L, AST 369 IU/L, WBC 9600 cells/L, platelets 90,000 cells/L, and CPK 860 IU/L. Her hypotension improved with aggressive fluid resuscitation. Repeat labs after transfer showed worsening thrombocytopenia, rhabdomyolysis with rising creatinine, and leukocytosis. Arterial blood gas showed mild metabolic acidosis (pH: 7.27, HCO3: 17 mEQ/L, lactate 25 mmol/L.) A botanist identified the ingested plant as *Colchicum autumnale*, later qualitatively confirmed with serum and urine colchicine levels using liquid chromatography-mass spectrometry. EKG showed sinus tachycardia. Chest X-ray showed pulmonary edema versus infiltrates, and she required nasal cannula at 5 LPM for 3 days. She was started on a benzodiazepine infusion for agitation. A sodium bicarbonate infusion was initiated for her acidosis and rhabdomyolysis with continued improvement in subsequent labs. On day 5 of her observation, severe neutropenia developed (ANA: 250 cell/L), that responded to 10 microgram/kg subcutaneous filgrastim. On hospital day 9, she was discharged after a full recovery.

Discussion: While colchicine tablets are more likely to cause colchicine toxicity, *Colchicum sp.* is an important cause to consider. Supportive care remains the mainstay of treatment in colchicine toxicity. Typically, there is little benefit from activated charcoal given rapid onset of GI symptoms. Hemodialysis is also of virtually no benefit in regard to drug removal given colchicine's large volume of distribution, though it could play a role in renal failure or pulmonary edema treatment. Filgrastim therapy can be effective in treating the neutropenia and potentially decrease the risk of sepsis.

Conclusion: Natural plant colchicine poisoning is difficult to recognize and can lead to severe toxicity. Therefore proper identification of the plant is important in order to guide subsequent therapies.

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191. Tea for two: forget the mountain wild honey – suspected grayanotoxin poisoning in a Nepali couple

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Background: Honey is commonly used as a food product along with multiple purported medicinal effects. Select honey harvested primarily in Nepal is known to contain grayanotoxins, which function as sodium channel openers in the central nervous system (CNS). This report describes a Nepalese couple who drank tea containing "Mountain Wild Honey" and developed symptoms consistent with grayanotoxin poisoning.

Case series: A husband (50 years) and wife (48 years) called emergency medical services (EMS) for nausea, vomiting, and dizziness shortly after drinking tea with 2 teaspoons of "Mountain Wild Honey" from Nepal. The wife had made tea with honey to treat symptoms of an upper respiratory infection and had made

a cup for her husband. Per EMS, the husband was also tachypneic and rigorous, but afebrile. On scene, she was described as hypotensive and bradycardic, and the husband had a blood pressure as low as 55/30 mmHg. On ED arrival approximately 45 minutes after ingestion, her initial vital signs were: blood pressure (BP) 85/54 mmHg, heart rate (HR) 53 beats/min (bpm); his BP was 86/58 mmHg, HR 48 bpm. Initial EKGs displayed sinus bradycardia with normal PR and QRS intervals, but her QTc was 474 msec and his was 455 msec. Elevated serum lactate was seen at 3.4 mmol/L and 3.9 mmol/L for wife and husband, respectively. Both patients had no significant medical history and were not taking any chronic medications. They denied access to calcium channel blockers or beta-blockers. They were initially treated with antiemetics and an intravenous (IV) fluid bolus. By 2 hours after ingestion, her repeat BP was 80/60 mmHg with a HR in 60's bpm despite 1 L of IV fluid and subsequent maintenance fluids. The husband's BP rose to 101/56 mmHg with HR consistently above 60 bpm and he subsequently remained asymptomatic. Both were admitted to the intensive care unit overnight. No ventricular arrhythmias were observed, and no vasoactive medications were administered. Seven hours after ingestion her BP and HR had risen to 90/55 mmHg and 56 bpm and she was asymptomatic. Sixteen hours after ingestion, both patients had normal BP and HR (144/67 mmHg and 88 bpm, 127/71 mmHg and 60 bpm) and they were discharged from the hospital.

Discussion: Grayanotoxin toxicity manifests with dizziness, altered mental status, nausea, vomiting, and cardiac depression secondary to its central effects on neuronal sodium channels. Both patients exhibited significant symptoms, that resolved quickly overnight with minimal supportive therapies.

Conclusion: Grayanotoxin poisoning secondary to Nepalese honey use was effectively managed with supportive measures and the patients returned to baseline by the next morning. When evaluating the poisoned patient, providers should remain cognizant of non-pharmaceutical, traditional, or natural therapies that patients may use at home.

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192. Mistaken identity: unintentional ingestion of colchicine containing plants

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Background: Plant foraging is common in the springtime. In the early stages of growth, some poisonous plants may mimic benign florae and result in toxic ingestions. We present a case of a patient with severe toxicity after inadvertently consuming a colchicine containing plant.

Case report: A 57-year-old female presented to an Emergency Department with nausea, vomiting, and diarrhea about 12 hours after reportedly consuming what was initially believed to be lily of the valley that she mistook for ramps. Vital signs were reportedly within normal limits upon arrival. Laboratory testing, including a basic metabolic panel and liver function testing were nonactionable; her digoxin level was negative. Her troponin was 0.09 ng/mL with a normal electrocardiogram. The patient remained hemodynamically stable but had persistent diarrhea requiring hospital admission. Her diarrhea persisted and on hospital day 3, the patient developed pancytopenia. White blood cell count (WBC) was 2,000/mL (23,000 mL on arrival). Her hemoglobin was 10g/dL (17g/dL on arrival) and platelet count was 30,000/mL (initial value not reported). Her troponin trended down to 0.03 ng/mL. Given the pancytopenia, ingestion of a colchicine containing plant was considered. There were no remnants of the ingested material however family provided photos of plants picked from the same location and they were consistent with autumn crocus.

Repeat lab testing on hospital day 4 showed a WBC of 2,600/mL, Hg of 10.7g/dL, and platelet count of 41/mL. Colony stimulating factor was started on hospital day 4. The patient remained in the hospital for a total of six days with improvement in her CBC prior to discharge. Colchicine testing was performed ordered on hospital day 3 and returned after discharge at 1.3ng/mL (reporting threshold 0.2ng/mL).

Discussion: In early stages of growth, many toxic plants, including Convallaria majalis (lily of the valley) and Colchicum autumnale (autumn crocus), can be misidentified as Allium tricoccum (ramps). Gastrointestinal symptoms occur within hours of ingestion of Colchicum autumnale. An initial leukocytosis may be seen followed by pancytopenia several days later. Elevated troponin levels may be seen typically within the first 24-72 hours. Ingestion of a colchicine containing plant was not initially considered because the reported ingestion was lily of the valley and the Toxicologist was not provided the CBC until hospital day 3. Fortunately, our patient responded well to supportive measures and colony stimulating factor.

Conclusion: A wide differential diagnosis should be considered even if patients report ingesting a certain substance as it can be misidentified. Clinicians should consider colchicine containing plants when patients present with gastrointestinal symptoms especially with an initial leukocytosis.

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193. A secondary analysis of adverse events and naloxone administration in intentional kratom exposures from 2013 – 2020 using the Toxicology Investigators Consortium (ToxIC) registry

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Background: Kratom, a plant indigenous to Southeast Asia that has dose-dependent opioid and stimulant effects, has gained popularity in the U.S. as a method of self-treating pain, anxiety, and opioid dependence or withdrawal. Kratom-associated toxicity, including seizures, cardiotoxicity, hepatotoxicity, respiratory toxicity, and death, are documented, yet likely remain underidentified and -reported. Likewise, naloxone administration has been recommended for reversing suspected kratom toxicity, yet few clinical data regarding prevalence and efficacy of this practice exist. Using the ToxIC registry, this study characterized kratom-associated toxicity in patients to whom naloxone was administered, versus not administered, in the presence and absence of coingestants.

Methods: This is a secondary analysis of data from the ToxIC registry, which prospectively collects prespecified data on all patients seen by the medical toxicologists. Inclusion criteria were all cases of intentional kratom exposures with and without

coingestants from 2013-2020. Intentional exposures were defined as purposeful use, misuse, and reported therapeutic use. We examined prevalence of adverse effects (e.g., seizures, hepatotoxicity, cardiotoxicity, signs and symptoms of the opioid toxidrome), kratom dose, and administration of naloxone. The primary outcome was the frequency of specific adverse events, including seizures, hepatotoxicity and cardiotoxicity. Secondary outcomes were the occurrence of the opioid toxidrome and the frequency of naloxone administration in cases of kratom-associated toxicity.

Results: Forty-one cases of intentional kratom exposure were identified, with kratom dosing not reported for most cases. Twenty-three patients presented with a coingestant. Coingestants included sedative-hypnotics (26.1%), sympathomimetics (17.4%), anticholinergic/antihistamines (17.4%), opioids (17.4%), herbs/supplements (17.4%), cannabinoids (17.4%), anticonvulsants (4.3%), antipsychotics (4.3%), and antidepressants (4.3%). Five coingestion cases (21.7%) were administered naloxone, with two of these showing coingestion of loperamide and U-47700. Respiratory depression, bradypnea, coma, and central nervous system (CNS) depression were documented in six (26%), three (13%), and seven (43%) cases, respectively. The opioid toxidrome was noted in two patients (8.7%). Three of 18 patients with a kratom-only ingestion (16.7%) were administered naloxone. Of the kratom-only ingestions, respiratory depression, bradypnea, coma and CNS depression were documented in three (16.7%), two (11.1%), and three (16.7%) cases, respectively. However, the opioid toxidrome was not diagnosed in any kratom-only ingestions. Seizures occurred in four of 41 total cases (8%). Hepatotoxicity was identified in a single patient (2.4%). One additional patient had hepatic injury with elevated bilirubin, and AST >100 but <1000U/L. Ventricular dysrhythmias was noted in two patients (4.9%), QTc prolongation in three patients (7.3%), and QRS prolongation in two patients (4.9%). Four patients were diagnosed with myocardial injury or ischemia (9.8%).

Conclusions: Adverse effects attributable to kratom-only exposure were few but reflect concerning symptoms requiring further study. Adverse events were reported more frequently in the presence of coingestants. Although some literature recommends using naloxone to reverse respiratory depression associated with kratom toxicity, few cases have been reported. This study showed that naloxone utilization is more common in kratom toxicity patients presenting with coingestants than in patients with kratom-only exposures. It is unclear if naloxone administration is effective in reversing kratom toxicity; further work to answer this question is ongoing.

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194. Envenomation by the African bush viper *Atheris squamigera*

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Background: The Green Bush Viper, *Atheris squamigera*, is found in west and central Africa. Reports of *Atheris* bites exist, but few details are provided. Mild symptoms include local swelling, pain, bruising, dizziness, nausea, and regional lymphadenopathy, but may progress to thrombocytopenia, coagulopathy, hemolysis, hemorrhage, and renal failure. There is no specific antivenom, but other viper antivenoms have been theorized to be efficacious. We report a case of a moderate bush viper envenomation that showed little response to treatment with antivenom.

Case report: A 36-year-old female presented after being bitten by a Green Bush Viper. The patient works in the reptile house at the zoo and was cleaning cages when she was bitten on her right hand. She reported immediate pain and bleeding at the site with subsequent swelling that progressed proximally. On arrival to the hospital, the patient was complaining of pain in her arm with associated nausea and headache. Vital signs were heart rate of 72 bpm, blood pressure of 132/78 mmHg, respiratory rate of 17 bpm, and oxygen saturation of 99% on room air. Exam was notable for two punctures on the right dorsal hand with surrounding edema and induration. There was some oozing from the wound which stopped within 10 minutes. The hand had full neurologic function, strong pulses, and brisk capillary refill. Labs were remarkable for a white blood count of 6.7TH/uL, hemoglobin of 12.2g/dL, platelets of 196TH/uL, PT of 10.9, PTT of 25, INR of 1.0, fibrinogen of 180mg/dL, D-Dimer of 224ng/ml, and creatinine kinase of 320U/L. A metabolic panel and transaminases were normal. The edema progressed to the entire upper extremity with increasing tightness, pain, and paresthesias. Distal sensation and capillary refill remained intact. No specific antivenom for this species was available, however, other African antivenoms were brought from the zoo. Based on previous case reports using antivenom from similar snake species, eight vials of Inoserp Pan-Africa F(ab)2 antivenom were administered in two vial increments without apparent effect. Platelets decreased to 92 and fibrinogen decreased to 76. Ten vials of Antivypmen Tri were administered, but swelling continued to progress into the axilla with regional lymphadenopathy. Ten vials of Anavip were then administered with no further progression. By the next morning, the patient's fibrinogen and platelet count had improved and her hemoglobin remained stable. On day 3, the patient's swelling decreased and she was discharged. Follow up labs on day 7 were without abnormality.

Conclusion: Bush viper envenomation is poorly reported and the optimal management remains unknown. Given the severity of symptoms seen in previous reports, our patient was administered available viper antivenom in the hope of moderating effects. However, minimal positive response was observed. While she ultimately developed only moderate symptoms without the organ failure or significant bleeding seen in previous cases, this may have represented the natural course of envenomation and may not have been due to efficacy of the administered antivenom. Until specific antivenom is developed to treat *Atheris* species envenomation, management remains primarily supportive.

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195. Persistent sensory deficit following pyrethroid misuse to combat bedbugs

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Background: Serious complications of pyrethroid pesticide exposure are most commonly seen after large ingestions with self-harm intent. We report a patient with persistent neurologic complaints following repeated excessive home application to eliminate bedbugs.

Case report: A 78-year-old man with type 2 diabetes (DM2) sprayed a product labeled as "Hot Shot Bed Bug Killer" (active ingredient cypermethrin) on his home bedding and furniture. He applied the substance repeatedly, approximately 1-2 times per week, and later became concerned about possible inhalation of

the pesticide. Following application, he sometimes washed or showered, but this was not done consistently. During this period, his wife was mostly staying at their daughter's house, and remained asymptomatic. After 2 months of this routine, the patient reported progressive lower extremity (LE) numbness and sensory loss to his primary care provider (PCP). The PCP attributed these symptoms to diabetic neuropathy. DM2 had been diagnosed approximately 6 years earlier, was treated only with metformin, and there was no documented history of neuropathy. The patient was skeptical of this diagnosis. He sought a second opinion at the emergency department (ED), where the history of pesticide exposure was elicited, and he was referred to the toxicology clinic. At the time of clinic visit 2 weeks later, he was alert and oriented with normal vital signs and motor function, but had symmetrically diminished light touch sensation in the distal LE. Routine metabolic panel sent from the ED included a glucose of 97 mg/dL with normal creatinine, electrolytes, and aminotransferases. Interestingly, the LE sensory loss had improved in the time since the patient's ED visit, and was much improved since the peak exposure 2 months earlier. Pyrethroid concentrations were not obtained due to the time lapse since peak exposure.
Discussion: Our assessment was limited by the fact that we saw this patient months after his peak exposure. The primary route of exposure appears to have been dermal, with some inhalational component. Although tissue concentrations were not obtained, LE sensory changes began with repeated exposure, and gradually improved with abstinence. Dermal pyrethroid exposure has been associated with paresthesias that are usually self-limited. In this case, the patient's age and DM2 may have contributed to the persistence of effect.
Conclusion: Repeated dermal exposure to pyrethroids for the purpose of eliminating bedbugs may place patients at risk for persistent neurologic effects.

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196. Getting the lead out with chronic kidney disease

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Background: Symptomatic lead toxicity is typically treated by administering a chelating agent that forms a complex with the metal, which is then cleared renally. When the patient has pre-existing end-stage kidney disease (ESKD), the situation is more complex, and a chelator must be chosen based on pharmacokinetics compatible with renal replacement therapy.
Case report: A 39-year-old woman with a history of hypertension and ESKD on intermittent hemodialysis 3 times/week presented to the emergency department with generalized abdominal pain and constipation for several days. She had been repeatedly (over the course of months) ingesting soil from her native country, along with broken up clay pots. Routine chemistry, CBC, plain abdominal films and CT were unremarkable, and urine pregnancy was negative. The patient was admitted to the internal medicine service for further work-up. A blood lead level (BLL) obtained on presentation later resulted at 78.8 mcg/dL, and toxicology was consulted. The patient was alert, oriented, and neurologically intact without evidence of encephalopathy. After discussion with the nephrology and pharmacy teams, we determined that the best treatment option in this case was $CaNa_2EDTA$, based on its low protein binding and small volume of distribution. $CaNa_2EDTA$ 1000 mg was infused via central venous catheter one hour before beginning the patient's standard 4-hour dialysis run. This procedure was performed a total of five times during the patient's 11-day hospital stay. Repeat BLL at this point was 34.1 mcg/dL, and the patient's abdominal pain had markedly improved. She was discharged with a tunneled central venous catheter, and appointments were scheduled to administer $CaNa_2EDTA$ in internal medicine clinic immediately preceding outpatient dialysis. The patient was also assessed by psychiatry and deemed to be safe for discharge with family. Outpatient chelation followed by dialysis was performed four times over a 12 day period, and subsequent BLL was 16.2 mcg/dL.
Discussion: This patient's presenting symptoms (abdominal pain and constipation) resolved as her BLL declined. She described a vaguely defined "craving" to ingest soil and pottery, similar to an urge she had felt when pregnant with her children, now grown. The patient seemed intent on working with family to avoid a recurrence of lead toxicity and, due to her chronic kidney disease, she has excellent follow up. In this case interdisciplinary collaboration between services – nephrology, internal medicine, toxicology, and pharmacy – facilitated lead clearance. Three chelating agents are generally used to treat lead toxicity in the United States. Oral dimercaptosuccinic acid might have been an option for a non-encephalopathic patient with normal kidney function, but high protein binding makes it poorly dialyzable. Structurally similar dimercaprol must be administered IM, and there is less experience using it as a single chelating agent.
Conclusion: For patients with metal toxicity in the setting of ESKD, interdisciplinary collaboration is crucial in the choice of chelating agent and timing of its administration.

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197. A tale of ice and fire

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Background: After a devastating forest fire season this past summer that generated an excess number of carbon monoxide (CO) calls to our Poison Center, the Pacific Northwest experienced one of its most debilitating ice storms in recorded history. Between February 13th and 15th, 2021, over 300,000 people within the Northern Willamette Valley lost power as electrical lines collapsed. To stay warm, alternative methods of heating were employed including running generators as well as burning charcoal fires and gas stoves indoors. Among the pre-hospital casualties was a family of four that was found dead upon arrival of emergency medical services.
Methods: We conducted a retrospective chart review of ice storm related Poison Center calls between February 13th and 19th, 2021. The search was restricted to the NPDS code for carbon monoxide. Deidentified demographic, exposure, and outcomes data was extracted and analyzed.
Results: There were 46 calls to our Poison Center involving 85 patients. The median age was 28 years old; 28% of calls affected children $\leq$18, 59% adults 19-64, and 13% elderly 65 and older. Women accounted for 57% of patients. The most common reported sources of CO exposure were generators (30%), gas stoves (28%), and charcoal fires (26%). Although syncope was reported in 39% of patients, a CO concentration over 25% was only noted in 10%. Two individuals experienced cardiac arrest in the pre-hospital environment; both were successfully resuscitated but one ultimately expired. Hyperbaric oxygen (HBO) was recommended for 22 patients and successfully completed for 12. One patient who had a syncopal event and an elevated troponin later refused HBO. Unfortunately, the power outage affected one of our states' three emergency-use hyperbaric chambers midway

through the natural disaster likely limiting who could have been treated.
Conclusions: Winter weather events leading to widespread power outages in the Pacific Northwest are rare. However, this review of demonstrates that there is ample opportunity for pre-emptive community engagement to minimize future harm. Education should focus on the dangers of using charcoal fires, camp stoves, and running generators indoors. Emergency public health measures to issue alerts by mobile phone are being explored as traditional communication sources such as radio, TV, and the internet may be inaccessible once a power outage arises.

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198. New paint stripper formulation causes significant dermal pruning and pain: a case series

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Background: In 2019, the Environmental Protection Agency banned methylene chloride in paint strippers for consumer use. There is limited information about the effects of exposure of replacement formulas. We report four cases of dermal exposure to Kwik Strip® containing 45% dimethyl carbonate, 20% dimethyl sulfoxide (DMSO), 20% xylene which caused painful infiltrative changes in the hands lasting several days. Additional cases have been reported to this poison center and others can be found on internet forums.
Case series: Case 1: A 36-year-old woman used the product for one hour even though it "ate right through the gloves." She reported the skin over the palmar surfaces was "wrinkled like a raisin and hard like leather" with significant pain. Aloe was recommended by an urgent care center and provided no relief. The poison center advised avoiding trauma to fingertips and resting the hands when possible. At 48 hours, both the pain and the pruning were improving.
Cases 2 and 3: Two adult men reported continuous use for 90 minutes despite glove deterioration after 20 minutes. Within 2 hours, they had pain, redness, swelling, and deep pruning to fingers described as the "texture of a morel mushroom." In Case 2, the affected area developed a bruised appearance. He initially applied silver sulfadiazine cream without relief and then changed to arnica gel and lotion. Swelling and pain decreased, and range of motion improved by day 4. The skin eventually desquamated with residual itching. He returned to work on day 7. Case 3 treated the hand with antibiotic ointment in a latex glove for several days and had full range of motion and no pain by day 6.
Case 4: A 32-year-old woman used the product for 1 hour without gloves. Within 2 hours her skin "felt like rubber" with deep wrinkles and intense burning. She was treated in an emergency room with morphine and ketorolac but soaking in water was the only intervention that provided pain relief. On day 2, the skin was peeling with intense itching and "looked like a morel mushroom." By day 8, skin was tight with reduced sensation, but pain was improving.
Discussion: This formulation contains the highly polar solvent DMSO, a skin penetrator and carrier of other chemicals. Wrinkled skin suggests expansion of surface area by absorption of liquid, such as occurs with prolonged water immersion. However, these patients had very deep skin folds with intense pain that took several days to resolve. Prolonged DMSO contact can induce a cellular infiltrate, which would explain this. DMSO may also enhance the penetration of other chemicals in the product (dimethyl carbonate, xylene, or small concentrations of other ingredients) which could contribute to the injury.
Conclusions: Newer paint remover formulations will likely have less potential for airborne exposures and systemic toxicity than methylene chloride. However, they have adverse dermal effects not yet fully characterized. We report a series of unusual skin reactions to a replacement formulation, without clear explanation of the mechanism of injury.

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199. Two fatal outcomes following intentional ingestion of sodium nitrite

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Background: Sodium nitrite is a common food preservative in cured meats and is one component of the traditional antidote regimen for cyanide poisoning. In recent years, it has become a method of self-harm attempts through "suicide kits" available online. We report two cases of fatal intentional sodium nitrite poisonings.
Case series: Case 1: A 24 year-old male called 911 after intentionally ingesting 30 g of sodium nitrite in a suicide attempt. Paramedics found him cyanotic with agonal respirations and weak carotid pulse. He suffered pulseless electrical activity (PEA) arrest en route and arrived at the emergency department (ED) with CPR in progress and supraglottic airway in place. He was unresponsive (Glasgow Coma Scale 3) with pupils fixed and dilated. He was intubated and ACLS protocol was initiated including aggressive fluid resuscitation, epinephrine, and bicarbonate. Asystole persisted on the monitor and his blood "looked like chocolate". Methemoglobin was 83.5%. Methylene blue infusion was started 30 minutes into the resuscitation effort, without clinical response. Ultrasound confirmed cardiac standstill and he was pronounced dead 1 hour after arrival to the ED.
Case 2: Paramedics called the poison center while on the scene with a 40 year-old male who intentionally ingested 2 ounces of sodium nitrite 15 minutes prior to their arrival. He vomited and verbalized to them that he would be unconscious within 20 minutes. The patient indeed became unresponsive and was intubated on scene. PEA arrest occurred during transport to the ED and his lips and face were cyanotic. The ED was prepared for his arrival with a double dose of methylene blue ready. ACLS protocol was continued unsuccessfully for 30 minutes with return of pulse for only a few minutes before he expired. Labs were not obtained.
Discussion: Sodium nitrite is a vasodilator causing hypotension and end-organ hypoperfusion. It is also a methemoglobinemia inducer with strong oxidizing capabilities. It oxidizes ferrous iron in the hemoglobin ring to ferric iron making it unable to transport oxygen leading to chemical asphyxia. It is sold to the general public for making cured sausages and other meats, as it contributes to their characteristic color and flavor and protects against botulinum formation. The rat oral LD50 is 150 mg/kg. An equivalent dose in a 70 kg human is only about 10 grams. It is freely water-soluble so is easy to ingest as a solution. One pound of sodium nitrite can be purchased on the internet for under $20.
Conclusions: As rates of suicides continue to increase, it is not surprising that individuals are turning to the internet as a resource for instructions and methods. Sodium nitrite is inexpensive, readily available online, and a potent toxin. Overdose leads to rapid progression of symptoms with a high mortality rate.

Poison centers must be aware of the severity of these cases and provide immediate recommendations for potential life-saving interventions.

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200. Subcutaneously injected detoxified *Naja kaouthia* venom for analgesia resulting in anaphylaxis

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Background: Therapeutic applications of snake venoms, which are thought to modify pain signaling pathways and notably ion channel function, have long been an area of interests for scientists and clinicians. In 1936 cobra venom was described by Malcht et al as a potential analgesic xenobiotic. In the 1950s Cobrotoxin, a short chain alpha-neurotoxin derived from the *Naja naja atra* snake, was studied after modification or detoxification for use in humans. Although there has been some interest in investigating detoxified *Naja spp.* venom as an analgesic adjunct over the last several decades; clear benefits and logistical challenges have limited further research and broader use.
Case report: A 50-year-old woman with a history of COPD and severe chronic pain was subcutaneously administered 20mg of expired research *Naja kauothia* venom by her husband in an effort to control her pain. The patient's husband previously participated in research detoxifying *Naja kauothia* venom by heating at 60C for three hours, filtering the solution and diluting with saline to a concentration of 10mg/mL. 2mL (20mg) of the solution that was produced in 2006 and expired in 2016 was administered in her left thigh. She had never been exposed to any snake venom in the past. She developed erythema, rash, and pruritis at the injection site within 2-3 minutes followed by chest tightness, dyspnea, wheezing, and throat discomfort two minutes later. EMS was called, and she was transported to the ED. Upon arrival her pulse was 110 bpm, BP was 180/86, respirations were 28 bpm, SpO2 was 100%, and her temperature was 98F. She was given epinephrine, albuterol, diphenhydramine, oxygen, and methylprednisolone to treat an anaphylactic reaction. She improved after three albuterol treatments and was able to be taken off oxygen. The patient left the emergency department against medical advice after she clinically improved.
Discussion: Cobra venoms have reportedly been modified or detoxified through various mechanisms including heating, treatment with 0.25% glutaraldehyde, use of ionizing radiation, and more. Detoxification aims to minimize the deleterious effects of the venom but preserve the beneficial effects. *Naja naja atra* venom has been studied for its effects on pain signaling, inflammation, immunoregulation, and even antiviral activities. However, our case however, demonstrates that minimizing its immunogenicity is likely to remain difficult. Our patient appeared to have a rather classic anaphylactic reaction to the venom that was introduced subcutaneously. Initially antivenin was considered, however the patient rapidly improved with treatment for anaphylaxis and left the ED against medical advice. Clinical improvement in the patient's pain was not able to be assessed.
Conclusions: Clinicians should be aware of the practice of detoxified snake venom use for the purported treatment of pain and the risk for allergic or anaphylactic reactions, even when administered subcutaneously. Rapid assessment and treatment for anaphylaxis should be considered, and antivenin may not be required.

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201. Coagulation conundrum: snake envenomation in a patient with hemophilia A

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Background: Current scientific literature is sparse on North American crotalinae envenomations to patients with underlying coagulopathy. The goal of this report is to present a patient with hemophilia A who was subsequently envenomated by an *Agkistrodon piscivorus* (cottonmouth).
Case report: A 29-year-old male with a past medical history of hemophilia A was envenomated over the right calcaneus by an *Agkistrodon piscivorus* (which was identified by the patient at the time). Initial vital signs were notable for blood pressure 132/71mmHg, HR 93 bpm, RR 16 breaths/min, oxygen saturation 97% on room air, and temperature 97.8F. On examination, the patient's right heel had a 'fang-like' bite mark with sanguineous ooze and surrounding ecchymosis (measuring ~5cm x 4cm). Circumferential edema extended from the bite area to the right mid-calf. The patient's hemoglobin was 13.2 g/dL, platelets 207 10^3/microL, INR 1.0, PTT 28, d-dimer 0.35 ug/mL, and fibrinogen 253 mg/dL. The patient's factor VIII activity was found to be 59% (ref range 50-131%). The patient received a double dose of Factor VIII on arrival and a loading dose of crotalidae polyvalent immune fab antivenin (6 vials) followed by standard maintenance dosing: 2 vials every 6 hours for three more doses. The patient remained hemodynamically stable throughout his four-day hospital stay and his ancillary studies ranged as following: hemoglobin 13.2-14.4 g/dl; platelets 190-300 10^3/microL; INR 0.9-1.2; fibrinogen 203-442 mg/dL. Hematology was consulted and the patient's goal Factor VIII activity was set to 100-200% of normal. Following treatment, his factor VIII activity ranged from 59 to 293% during admission. He was discharged after an uneventful hospital admission with complete resolution of all symptoms.
Discussion: Potential challenges were quickly identified in this patient who remained at high risk of systemic bleeding from both intrinsic depletion of factor VIII along along with local toxic effects from an *Agkistrodon* envenomation. Factor VIII is ultimately responsible for activation of factor Xa, leading eventually to formation of fibrin cross linked products. Venom induced consumptive coagulopathy (VICC) is a syndrome evidenced by thrombocytopenia, hypofibrinogenemia, and potentially several clotting factor derangements. While this syndrome is not usually seen in *Agkistrodon* envenomation, some patients will develop mild thrombocytopenia and hypofibrinogenemia. This mild decrease has the theoretical concern to be greatly magnified in patients who already have difficulty forming fibrin cross linked products. Current literature is lacking about whether *Agkistrodon* species can precipitate a functional decrease of factor VIII itself. Finally, there existed an increased concern for localized tissue damage and bleeding from the trauma of the snake bite, similar to the complications that hemophiliacs have contending with other mild trauma. Despite these concerns, the patient had a good outcome with standard treatment involving localized wound care, crotalidae polyvalent immune fab antivenin, and empiric factor VIII repletion.
Conclusion: Little is known about North American snake bite management in those with Hemophilia A or B but systemic

coagulopathy has propensity to be magnified in these patients. Administration of Factor VIII and antivenin, even in the absence of symptoms of systemic toxicity, appeared beneficial in this single report.

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202. Carbon monoxide poisoning and hearing loss

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Background: Carbon monoxide (CO) is a colorless, odorless, tasteless, and nonirritating gas that is formed by the incomplete combustion of a carbon-containing material. According to National Safety Council, it accounts for approximately 400 unintentional deaths, more than 20,000 emergency department visits and more than 4,000 hospitalizations each year in the United States. Carbon monoxide binds to hemoglobin with an affinity of 250 times that of oxygen, resulting in impaired oxygen delivery, cellular hypoxia and ischemia resulting in significant morbidity and mortality. Sensorineural impairment, or deafness has been reported in association with CO toxicity. Impairment can be temporary or permanent. It is yet unknown the exact cause of this effect but it is believed to be a result of damage to the cochlea, the 8th nerve, or even brain stem nuclei. Although uncommon, the proportion of patients with CO poisoning associated with deafness is unknown.
Case report: A 45-year-old male was found unresponsive in a running vehicle in a parking lot. Upon arrival to the Emergency Department, he was intubated following multiple episodes of apnea. Given his level of sedation, respiratory depression and pinpoint pupils naloxone was administered with no effect. Urine drug screen was positive for amphetamine, methamphetamine and cannabinoids and negative for opiates. CT of Head was negative. Chest X-ray showed no acute lung disease. Carboxyhemoglobin level drawn after intubation was 23%. Patient was admitted to the ICU with naloxone and propofol drips. FiO2 was increased from 50% to 100%. The following morning patient was extubated was neurologically intact except for reported deafness. The regional poison center was contacted, and hyperbaric oxygen was recommended. Patient was transferred to a facility with this capability and treated with two dives in the hyperbaric chamber. Hearing was greatly improved, and the patient was discharged home.
Discussion: A search of the National Poison Data System identified 953 deaths related to CO exposure between 2000 – 2019. During this time, 238,036 cases of CO were reported to U.S. Poison Control Centers. Only 9 of them listed deafness as a clinical effect. Of these, 7 were exposed to CO alone. One case with co-exposures included ethanol and miscellaneous drugs. The other case involved exposure to heroin. High flow oxygen and hyperbaric oxygen treatment (HBOT) were either used or recommended in all cases. There is no definitive correlation that either therapy resolved the patient's deafness related to the exposure.
Conclusions: Evaluation for sensorineural hearing loss following CO exposure is imperative as it can result in significant morbidity and HBOT may be beneficial in these cases. Future research should focus on the value of HBOT in CO-induced sensorineural hearing loss.

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203. Implementation of updated joint trauma system clinical practice guidelines for snakebite envenomations in Africa via module based learning

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Background: In the U.S. Army, all active-duty Special Forces groups have a specific regional orientation. 3rd Special Forces Group (Airborne) trains for and deploys to missions primarily in Sub-Saharan Africa. Conducting training and combat operations in a variety of remote locations across the continent, snake envenomation is a rare but potentially deadly risk to these special operators. In many cases evacuation to a higher echelon of care may take several hours or days. Special Forces Medical Sergeants receive extensive training in trauma and non-trauma skills, but training in management of snake envenomation has historically been non-standardized or lacking. In 2020, the Joint Trauma System published a new Clinical Practice Guideline (CPG) on Global Snake Envenomation Management to bring clinical guidelines up to the standard of care in various regions. A pilot study was done to evaluate the effectiveness of computer-based module training using the up-to-date CPGs at an US military base in Africa.
Methods: U.S Army healthcare workers including physicians, paramedics, special operation medics, and other medical personnel participated in a series of educational modules focused on improving their understanding snakebite envenomation syndromes in Africa. They then completed several modules on the recommended field treatments of snakebite envenomations. Each module had specific learning objectives. After completing the modules, a 25-question multiple choice open book test was administered using real world envenomation scenarios. The test was open book to mimic participants being able to use key references during an active envenomation. After the test, an end of course self-evaluation was administered assessing the perceived improvement in knowledge of the participants.
Results: A total of 41 participants completed the modules and the test with a median test score of 84.93 with a standard deviation of 6.42. Thirty-seven of the participants went on to complete the course evaluation. The participants' level of training varied between residency trained (N = 2, 5.4%) and fellowship trained (N = 2, 5.4%) physicians, special operation medics (N = 23, 62.2%), paramedics (N = 1, 2.7%), corpsmen (N = 3, 8.1%), EMT-B (N = 1, 2.7%), and non-medical personnel (N = 1, 2.7%). Before starting the training modules, 13.5% participants felt "very knowledgeable" (N = 1, 2.7%) or "knowledgeable" (N = 4, 10.8%). The other 86.5% felt they "knew a little bit" (N = 14, 37.8%), "did not know much" (N = 12, 33.4%), "knew nothing" (N = 4, 10.8%), or did not answer (N = 2, 5.4%). Twenty-nine participants (70.7%) either "strongly agreed" or "agreed" the training was easy to navigate with another five answered "neither agree nor disagree". Thirty participants (86.5%) "strongly agreed" or "agreed" the scenarios was realistic, with only one participant disagreeing. After the training, thirty-three (94.5%) participants "strongly agreed" or "agreed" that they could effectively manage a snakebite envenomation in Africa with appropriate resources. No participant disagreed.
Conclusion: Our initial results indicate that medics and other healthcare providers are able to apply the Clinical Practice Guidelines in case-based simulated snakebite scenarios, and that

learners generally feel that this training method gives them confidence in their ability to manage real-world snakebites in an austere environment. Further studies need to be done to determine knowledge retention in real world situations.

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204. Intentional arsenic metal self-poisoning

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Background: Arsenic can be a potent human toxin. The clinical effects depend on the species of arsenic. Elemental arsenic is rarely encountered in medical or occupational toxicology.
Case report: A 33-year-old woman with a past medical history of bulimia, anxiety, depression, post-traumatic stress disorder, and hypothyroidism was evaluated after ingesting approximately 10g of elemental arsenic. The substance was purchased online as a collectible in a vial marked "99.9+%" pure arsenic. The metallic sample was pulverized with a mortar and pestle and added to a cup of coffee which was entirely consumed. Within 30 minutes she developed nausea and induced vomiting. She noticed black particulate in her emesis. Shortly, she developed two episodes of diarrhea which were black in color. These symptoms prompted presentation to a local hospital. Poison control was consulted and dimercaprol was recommended. As the local hospital did not have any dimercaprol she was transferred to a tertiary-care hospital with a medical toxicology consult service 12 hours after the ingestion. She was asymptomatic with a normal physical examination. Repeat laboratory studies at that time showed a white blood cell count of 10.4 k/cumm, hemoglobin 13.2 g/dL, platelet count 275 k/cumm, bicarbonate 23 mmol/L, creatinine 0.66 mg/dL, glucose 115 mg/dL, bilirubin 0.7 mg/dL, AST 16 U/L, ALT 11 U/L, iron 54 mcg/dL, salicylate <1 mg/dL, and acetaminophen <5 mcg/mL. ECG showed normal sinus rhythm with sinus arrhythmia, HR 82 bpm, QRS 64 ms, QT/QTc 418/488, otherwise normal tracing. She received dimercaptosuccinic acid (DMSA) 500 mg (9.24mg/kg) orally every 8 hours for three days. She remained asymptomatic and was discharged after psychiatric evaluation. Blood and urine arsenic samples from approximately 12 hours after ingestion, and obtained prior to DMSA administration, were 113.8 mcg/L (serum),>5000 mcg/L inorganic arsenic (urine), and <5 mcg/L organic arsenic (urine). Inorganic arsenic/creatinine ratio in urine was >1931 mcg/g creatinine. Repeat serum arsenic at 36 hours post-ingestion during DMSA therapy was 109 mcg/L. Arsenic testing was performed at a reference laboratory and was not available during the hospitalization. At 2-week outpatient follow up she remained asymptomatic with no evidence of arsenic toxicity on physical examination. Serum arsenic was 5 mcg/L and urine arsenic 87 mcg/L (inorganic) and 22 mcg/L (organic) 19 days post-ingestion.
Discussion: Metal arsenic ingestion is rarely reported and is assumed to be non-toxic due to its insolubility in water including body fluids. Laboratory results from this case show arsenic metal is readily absorbed from the GI tract and present in both blood and urine samples weeks after ingestion. Furthermore, the speciation of urine arsenic into organic and inorganic forms does not discriminate toxic trivalent arsenic compounds from reportedly harmless elemental arsenic. Empiric DMSA was used with no appreciable effect. Although the ingested substance was reported as arsenic metal, no rapidly available laboratory test could confirm this diagnosis.
Conclusion: In this case of ingestion of approximately 10g arsenic metal there was a rise in serum and inorganic urinary arsenic and brief, self-limited, gastrointestinal effects; however, no significant clinical effects were observed by 2-week follow up.

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205. Intentional quetiapine ingestion in an adolescent patient resulting in delayed hypoglycemia

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Background: Quetiapine is an atypical antipsychotic with serotonin antagonist and dopamine antagonist effects. Overdose of quetiapine can induce CNS depression and can cause an anticholinergic toxidrome secondary to the active metabolite, norquetiapine. Cases in the literature of hypoglycemia associated with quetiapine exposure are rare. We describe an acute quetiapine ingestion in an adolescent patient resulting in delayed hypoglycemia.
Methods: A 13-year-old female ingested an unknown quantity of quetiapine tablets prior to being found unresponsive by family members with an empty bottle of 300mg quetiapine tablets. She was transported to the emergency department where she was intubated for airway protection secondary to depressed mental status. On presentation the patient had a temperature of 96.8 F, pulse 150 bpm, respiratory rate 15 breaths/minute, SpO2 94% on room air, blood pressure 107/53mmHg. Her temperature decreased to 93.2 F six hours later with improvement to 100 F 9 hours after presentation. 49.5 hours after presentation to medical care she developed hypoglycemia to 50 mg/dL and then at 52.5 hours her glucose was 26 mg/dL requiring D50 bolus followed by maintenance with D5LR for three days. After dextrose containing fluids were started her serum glucose remained normal for the remainder of the hospitalization. Her tachycardia on presentation persisted until hospital day 8 before resolution. Infectious workup, including CSF, blood, and urine cultures was unremarkable. MRI showed no acute intracranial abnormality. Her mental status gradually improved, and she was successfully extubated 3 days after admission. Following extubation, the patient reported quetiapine ingestion and denied co-ingestion. She was discharged to an inpatient psychiatric facility in good condition. A serum quetiapine concentration (NMS Labs, high performance liquid chromatography/tandem mass spectrometry) obtained at time of presentation was 870 ng/mL.
Discussion: Hyperglycemia is a recognized side effect of quetiapine. Hypoglycemia induced by quetiapine and other second-generation antipsychotics has been described in case reports of adult patients, even with therapeutic dosing. The mechanism of quetiapine-induced hypoglycemia is unknown but may be caused by increased basal insulin secretion from pancreatic β-cells. Our case demonstrates delayed hypoglycemia associated with a quetiapine concentration which is above the therapeutic threshold.
Conclusion: Quetiapine overdose can cause delayed hypoglycemia requiring dextrose supplementation. This case provides an example of hypoglycemia that developed over 48 hours after quetiapine ingestion.

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206. Inhalational injury and diffuse airway edema after inhalation of zinc oxide

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Background: Zinc oxide is a common zinc salt that is in a variety of products including baby powder and sunscreen. Exposure to zinc chloride can cause serious pulmonary injury following inhalation, while zinc oxide leads to metal fume fever after chronic exposure in welders. Acute inhalation injury of zinc oxide is poorly described in the literature. We present the case of a patient who developed oropharyngeal edema and lower airway injury after acute inhalation of zinc oxide.
Methods: This is a case review. A 38-year-old male with unclear medical history was operating a semi-truck carrying zinc oxide powder. The truck was involved in a traffic collision resulting in zinc oxide spilling into the passenger compartment of the vehicle. The patient was transported to the ED, covered in white powder. He initially presented in no acute distress but rapidly developed stridor and respiratory distress. He underwent rapid sequence intubation for progressing airway compromise. During the procedure he was noted to have copious bloody secretions and tongue and posterior oropharyngeal edema. ED evaluation revealed bilateral nondisplaced mandible fractures and right second and third rib fractures. The remainder of his imaging and labs were unremarkable. The patient underwent bronchoscopy the day of admission which revealed grade 2 inhalational injury with moderate erythema and copious amounts of thick white material suspected to be zinc oxide (photos available). Bronchoalveolar lavage was performed. The patient was extubated on hospital day 2 but had ongoing altered phonation. On hospital day 3, he had surgical fixation of his mandible fractures and had marked airway edema preoperatively requiring nasotracheal intubation. Systemic steroids were initiated at this point and continued for 24 hours. He underwent repeat bronchoscopy on hospital day 4 that showed marked improvement of lower airway erythema and reduction in the amount of zinc oxide retained in the airway. Patient was successfully extubated on hospital day 5 to 4L oxygen by nasal cannula and remained hospitalized to recover from his traumatic injuries and aspiration pneumonia.
Discussion: Zinc oxide is generally considered less toxic than other zinc salts namely zinc chloride. This case demonstrates the potential for a zinc oxide inhalation exposure to result in significant irritant effects to the pulmonary tract and the need for respiratory support.
Conclusions: Inhalational of zinc oxide powder has the potential to induce both upper and lower airway injury and subsequent respiratory compromise.

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207. Chlorfenapyr toxicity

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Background: Chlorfenapyr, an N-substituted halogenated pyrrole, is a broad-spectrum insecticide. The insecticidal activity of chlorfenapyr depends on its biotransformation by hepatic mixed function oxidases to tralopyril, which uncouples mitochondrial oxidative phosphorylation and disrupts adenosine tri-phosphate production. Although chlorfenapyr's mechanism of action has been elucidated, human chlorfenapyr poisoning is not well characterized and the management of chlorfenapyr exposure is unclear. The purpose of this work is to characterize human chlorfenapyr poisonings, its laboratory and imaging findings, and propose a management plan for human chlorfenapyr exposure.
Methods: We systematically searched EMBASE, Google Scholar, PubMed, and Web of Science from inception to March 2021 across all languages. Non-English publications were translated using either Google Translate or primarily translated by our authors. The search strategy included "human," "chlorfenapyr," and "tralopyril." We excluded *in vitro* studies, animal studies, and environmental impact studies. Abstracts from scientific conferences with sufficient description of exposure and clinical course were included. Conversely, abstracts from scientific journals were excluded if we were unable to subsequently obtain the full text article. We then performed a review of the citations of included studies, culling articles which met inclusion and exclusion criteria. The study conforms to the Preferred Reporting for Systematic Reviews and Meta-analyses guidelines.
Results: Our systematic search identified 1143 publications of which 23 met study inclusion criteria. One of these studies did not include sufficient information for analysis and was excluded yielding 22 studies with patient level data and 34 cases of human chlorfenapyr poisoning. Chlorfenapyr poisoning occurred via ingestion (91%), inhalation (3%), dermal exposure (3%), and intra-abdominal injection (3%). The mean time from exposure to symptom onset was 3.3 days (range 0-14 days) for all patients, though this was shorter amongst those who died (2.6 days) than in those who survived (7.0 days). The most frequently reported symptoms at presentation were diaphoresis (44%), nausea and/or vomiting (26%), and altered mental status (24%). Fever (38° C) was uncommon at presentation (9%) but developed in 55% of the patients. Elevated creatinine kinase was the most frequently reported abnormal laboratory result (44%) during hospital course, and neuroimaging studies were notable for diffuse bilaterally symmetrical white matter changes in the central nervous system (33%).
Chlorfenapyr poisoning is associated with a high mortality (73%). Fever was an ominous clinical sign and it often preceded hemodynamic collapse and death. Amongst patients who died, mean time to death was 7.9 days (range 2-20 days). Of the survivors, 38% incurred neurological sequelae (e.g., paraparesis and vision loss). Management of chlorfenapyr exposure and treatment of chlorfenapyr toxicity were highly variable between cases, and the effectiveness of any specific treatment is unclear.
Conclusion: Human chlorfenapyr poisoning is characterized by a latent period as long as 14 days, deterioration over hours to days, variable abnormal laboratory results, and distinctive neuroimaging findings, and is associated with high mortality. We propose a management algorithm for patients who are exposed to chlorfenapyr based on characterization of chlorfenapyr poisoning.

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208. Management and associated toxicokinetics of massive valproic acid ingestion with high flow continuous venovenous hemodiafiltration

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Background: Valproic acid (VPA) toxicity commonly results in a self-limited state of CNS depression that is managed with

supportive care and L-carnitine. In massive overdose, patients can develop toxic encephalopathy, shock, metabolic acidosis, multisystem organ failure, and death. We present a case with relevant toxicokinetics of a patient with the highest ever documented VPA concentration to result in survival with supportive care including high clearance continuous venovenous hemodiafiltration (CVVHDF).

Case report: A 17-year-old female with history of bipolar disease presented to an emergency department (ED) after being found unresponsive at home at 08:00 (last seen normal approximately 12 hours prior) with concern for acute ingestion of 44 g of VPA. Upon arrival she was obtunded, and blood pressure was 89/46; her initial VPA concentration was 2226 mg/L, estimated 9 hours post-ingestion. She was intubated, received 50 g activated charcoal, 100 mg/kg IV L-carnitine and transferred to a tertiary children's hospital.

On arrival, she remained hypotensive and required multiple vasopressors. Notable laboratory abnormalities included venous blood gas demonstrating pH 7.17 and PvCO2 38 mmHg, bicarbonate 10 mmol/L, lactate 16.1 mmol/L, and ammonia 127 mmol/L. High clearance CVVHDF (~8,000 ml/min/1.73m^2 vs. 2,000 – 3,000 ml/min/1.73m^2) was initiated shortly after arrival. Her apparent VPA half-life prior to initiation of CVVHDF was 7.3 hours which shortened to 6.2 hours during CVVHDF and lengthened to 20.6 hours post-CVVHDF. She remained on CVVHDF for 18 hours by which time her VPA concentration returned to therapeutic range and acidosis resolved.

Her clinical course was complicated by shock, necrotizing pancreatitis with secondary diabetes, hypernatremia, acute kidney injury, pancytopenia requiring multiple transfusions of platelets and packed red blood cells, coma and seizures. Ultimately, she recovered with normal neurological function and discharged to home after a 22-day hospitalization.

Discussion: The highest reported VPA concentration in the literature is 2725 mg/L in a forty-year-old female who died 72 hours after ingestion. This case represents the highest reported concentration of VPA to result in survival. Her development of encephalopathy, acidosis, pancreatitis, pancytopenia, and shock are classic manifestations of the most severe toxicity. In large overdose the non-protein bound fraction can be removed with hemodialysis (HD).

HD is recommended over continuous renal replacement given evidence for superior VPA clearance (half-lives 2.5 vs 9.6 hours, respectively). The VPA clearance achieved with high clearance CVVHDF in this case was similar to that seen in prior reports with this modality, and her VPA half-life shortened only marginally from pre-CVVHDF. However, CVVHDF was effective in rapidly correcting the patient's severe metabolic derangements with no negative impact on her hemodynamics. It is unclear if HD and more rapid removal would have prevented her subsequent complications for VPA toxicity and CRRT has potential advantage of preventing secondary redistribution.

Conclusion: A patient with profound VPA toxicity was successfully managed with excellent critical care and CVVHDF. This case redemonstrates that while HD is the preferred modality for extracorporeal VPA removal in massive overdose, CRRT strategies may have a role in patients who are hemodynamically unstable.

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209. Automatic dishwasher detergent pod exposures treated at emergency departments

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Background: Automatic dishwasher detergents (ADDs) differ from hand dishwashing detergents by containing ingredients such as strong alkalis, corrosion inhibitors that protect the dishwasher's metal components, enzymes that break down food, and foam suppressors to prevent foam from interfering with the cleaning action. The ingredients that make ADDs effective at removing foods also make them potentially hazardous if they are ingested, inhaled, or come in contact with the skin or eyes. ADDs are available in a variety of formulations, including packs or pods. The objective of this study was to characterize ADD pod exposures managed at United States (US) emergency departments (EDs).

Methods: Data 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. 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 ADD pod exposures reported during 2000-2019, all records with the letter combinations "pod," "pac," or "pak" in the record narrative and also mentioned "dishwasher" in the narrative or were assigned product code 0934 (Dishwasher detergents) were reviewed, and those that appeared to be ADD pod exposures were included in the study. The distribution of estimated ADD pod exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.

Results: A total of 138 ADD pod exposures were identified, resulting in a national estimate of 4,612 exposures. No exposures were identified prior to 2006; the estimated number of exposures increased from 31 in 2006 to 957 in 2018 and declined to 551 in 2019. The patient age distribution was 4,212 (91.3%) 0-5 years, 15 (0.3%) 6-12 years, 5 (0.1%) 13-19 years, and 380 (8.2%) 20 years or older; 2,513 (54.5%) of the patients were male and 2,098 (45.5%) female. The patient's race was 2,372 (51.4%) white, 291 (6.3%) black/African American, 17 (0.4%) Asian, 239 (5.2%) other, and 1,692 (36.7%) not stated. The route of the exposure was 3,798 (82.3%) ingestion, 595 (12.9%) ocular, and 219 (4.7%) dermal. The reported location where the exposure occurred was 4,269 (92.6%) home, 74 (1.6%) other public property, and 268 (5.8%) not recorded. The diagnoses were 3,792 (82.2%) poisoning, 287 (6.2%) dermatitis/conjunctivitis, 207 (4.5%) chemical burn, 144 (3.1%) contusion/abrasion, 70 (1.5%) ingested foreign object, and 111 (2.4%) other/not stated. The patient disposition was 4,352 (94.4%) treated or examined and released, 95 (2.1%) treated and transferred to another healthcare facility, 153 (3.3%) treated and admitted for hospitalization, 6 (0.1%) held for observation, and 6 (0.1%) left without being seen/against medical advice.

Conclusion: ADD pod exposures treated in EDs increased during 2006-2018. The exposures most often involved patients who were children age 0-5 years and male. The majority of patients were treated or evaluated and released from the ED.

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210. Teletoxicology in the time of COVID

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Background/Objectives: The role of telemedicine expanded over the past year due to the present pandemic. Importantly, telemedicine offers a venue for toxicologists to sustain or expand their practice. We used the Toxicology Investigators Consortium (ToxIC) Core Registry to determine how toxicologists used telemedicine during the pandemic.
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 United States and 4 sites internationally. A new set of telemedicine questions was added to the registry on April 1, 2020. We searched the ToxIC registry from April to December 2020 to determine how medical toxicologists were using telemedicine. Only cases receiving a telemedicine evaluation were included. Data collected included: description of telemedicine encounter (video/internet, phone, chart review); the reason telemedicine 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: In 2020, 6668 patients were enrolled into ToxIC, of which 144 (3%) included a telehealth encounter. The majority of encounters were toxicologists acting as consultants in either the emergency department (ED) or on the medical wards (n = 126; 88%) with 13 (9%) occurring in clinic and 5 (3%) performed by an inpatient toxicology service. The ED was the primary source of referral (n = 74; 51%) with the admitting team being the source for 50 patients (34%). Most evaluations occurred in the ED (n = 70) with the rest occurring either on the medical ward (n = 39) or intensive care unit (n = 22) or other (n = 13). Fifty-one percent (n = 73) of telemedicine encounters were only chart reviews while 54 (38%) were by video/internet, 16 (11%) were conducted over the phone and 1 was unknown. Only fifty-two percent (n = 75) of encounters were billed. Sixty-five (45%) encounters occurred via telemedicine as opposed to in person due to the risk of infection while 14 (10%) were due to a change in hospital policy. Very few encounters (n = 7; 5%) were primarily for addiction medicine with 83% of those being for the initiation of opioid agonist therapy and only 1 for assistance with pain management. No telemedicine encounters were for adverse drug reactions or medication errors. Toxicologists provided a therapeutic intervention via telemedicine to 94 separate patients (65%).
Conclusions: Use of telemedicine by medical toxicologists was infrequent. Most telemedicine encounters were consultations performed in the emergency department. Nearly half of the telemedicine encounters were due to concerns of spreading an infection from an in-person evaluation. Very few encounters were primarily for addiction medicine and medical toxicologists only billed for approximately half of the encounters reported. Given the infrequent use, this represents a potential growth area in medical toxicology practice.

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211. Validity of vital signs, coma scales and modified APACHE score in prediction of prognosis and outcome of acutely poisoned patients

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Background: Poisoning is a public health problem and is one of the most common reasons for attendance at hospital emergency departments. Early diagnosis and treatment in emergency department and ICU are critical for the poisoned patient to reduce hospital morbidity and mortality. Aim Of the Work: Evaluation of the validity of coma scaling systems as GCS, Reed scale, poisoning severity score (PSS), modified APACHE score (MAS) and vital signs as predictors of clinical course and outcome of acutely poisoned patients.
Methods: This retrospective study was carried out on 100 acutely intoxicated patients, who were selected from patients attended Sohag University Hospitals.
Results: This study revealed that 62% of the patients were in the age group 18-30 years old and 63% were females. The majority of them intoxicated by oral route 91% and most of them were suicidal 68%. For the outcome 75% of patients had been survived and 25% of patients died. PSS, Reed, MAS and GCS as coma scaling scores at admission showed significant difference between survivors and non-survivors of these patients. Systole and diastole as parameters of vital signs also showed significant difference between survivors and non-survivors. While, pulse, temperature and respiratory rate were non-significant differ between survivors and non-survivors. ROC curve analysis was used to make assessment of the predictors of fatality. The accuracy rate of PSS, Reed scale, MAS and GCS were (92.0%), (86.6%), (84.8%) and (80.9%) respectively with excellent discrimination. The accuracy rate of diastolic and systolic blood pressure were (79.7%) and (76.7%) respectively, with acceptable discrimination as predictors of mortality.
Conclusion: The study concluded that PSS, Reed scale, MAS, GCS, diastole and systole respectively are valid prognostic tools for the outcome in acutely poisoned patients. Measuring PSS, Reed scale, MAS, GCS and vital signs at admission can be used as easy accurate parameters for triage of acutely poisoned patients.

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212. Retrospective review of digoxin toxicity reported to a regional poison center

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Background: Digoxin is a cardioactive steroid (CAS) indicated for rate control in patients with atrial fibrillation or flutter and for heart failure with reduced ejection fraction. Off-label uses include sustained fetal supraventricular tachyarrhythmia and rate control in patients with supraventricular tachycardia. Before the availability of digoxin immune fab (DIF), CAS toxicity resulted in a mortality rate of 58% for those greater than 60 years old, 8% in patients younger than 40 years, and 34% in those 40-50 years old.
The current FDA-approved and available digoxin immune fab is marketed under the brand name DIGIFab®. Despite clear indications in the package insert, there remains significant variability regarding its clinical use, dosing, and monitoring parameters.
This is a retrospective chart review to help understand clinical utilization patterns of DIF. We characterize these exposures and determine the most frequent indications for use of DIF.
Methods: A retrospective chart review of human CAS exposures reported to the Oklahoma Center for Poison & Drug Information was conducted. All single-substance human exposures between

1/1/2006 and 3/15/2020 evaluated in a healthcare facility were included. Data collected included patient demographics, reason for and amount of exposure, clinical effects and duration, laboratory values, treatments, caller and management site, and outcome. Exclusion criteria included inability to follow to known outcome and exposures managed on-site (not a healthcare facility).

Results: 103 CAS exposures met inclusion criteria, with an average of 6.9 per year (range 3-13) with the most recent 5 years averaging 8.2. Adults represented the majority (74.8%) of cases with average age being 51.4 years. Exposures were most commonly due to unintentional therapeutic errors (39.8%) followed by adverse drug reactions (19.4%).

The most frequently occurring related symptoms were bradycardia (36.9%), electrolyte abnormality (primarily hyperkalemia, 26.2%), and nausea (16.5%). Of the 103 exposures, a total of 33 received DIF therapy; a medical or clinical toxicologist made a recommendation for DIF in 48% of those cases.

The median digoxin level was evaluated for each of the clinical outcome categories: no effect, minor effect, moderate effect and major effect. The median was found to be 4, 3.5, 3.1, and 3.8 ng/mL respectively with a range of 0.3-26. A Kruskal-Wallis test revealed no statistical difference when comparing digoxin levels to clinical outcome. There was not a strong correlation between a digoxin level and when a medical or clinical toxicologist recommended DIF therapy.

Conclusions: Though CAS use has decreased over the last 15 years major outcomes related to these exposures continue to occur, therefore healthcare facilities and clinicians must be prepared to emergently treat patients experiencing toxicity. Digoxin levels alone did not usually prompt DIF therapy recommendation in the absence of symptoms. Timing of digoxin levels is paramount when evaluating patients following an acute exposure, as both the highest and lowest digoxin levels recorded resulted in no effect. The therapeutic effects that usually prompted a toxicologist to recommend DIF therapy were bradycardia, hyperkalemia, and nausea.

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213. Rapid development of severe nicotine toxicity following dermal exposure to a nicotine/DMSO solution

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Background: Severe nicotine toxicity causes a constellation of symptoms indistinguishable from organophosphate or chemical nerve agent poisonings. We present a woman who rapidly developed severe nicotine toxicity after dermal exposure to a nicotine/dimethyl sulfoxide (DMSO) solution.

Case report: A 34-year-old female immigrant from Belarus was at a neighborhood park when her Russian ex-husband, and PhD-level chemist, doused the back of her neck and shoulders with "water". Alarmed, she called 911 believing she had been poisoned. Within 5-10 minutes she developed paresthesias of the exposed skin which quickly spread to the rest of her body, blurry vision, confusion, chest tightness with dyspnea, a pungent/spicy taste in her mouth, and profound weakness with inability to walk. When paramedics arrived (10 minutes later) she was unable to move her fingers and toes or rise from a seated position. She was anxious with mumbling, semi-coherent speech, had pinpoint pupils, and developed severe nausea and vomiting.

In the ED her initial pulse was 128 and respiratory rate was 28 breaths/minute but her other vitals were normal. Over the next hour she became progressively hypotensive (systolic blood pressure in 80s), bradycardic (to the high 20s), and hypothermic (34.5 °C). She was examined at the bedside by a medical toxicologist and underwent full decontamination. Her symptoms peaked around 2.5 hours post-exposure, however, her hemodynamics then rapidly and unexpectedly improved over the next hour with intravenous fluids and antiemetics. She never developed hypoxia or tachypnea and did not receive atropine or pralidoxime. Laboratory studies revealed a lactate of 5.1 mmol/L with a hyperchloremic metabolic acidosis. Electrocardiogram showed sinus bradycardia. Ultimately, her symptoms resolved over the next 12 hours.

Given the concern for the use of chemical warfare agents, the FBI, local Police Department, US military, and Minnesota Department of Health (MDH) were all heavily involved and an extensive investigation and decontamination ensued. Exhaustive laboratory evaluation by the MDH revealed a urine cotinine level of 5160ng/mL (normal: 10-30ng/mL in a light smoker, up to 500ng/mL in a heavy smoker), the primary metabolite of nicotine. Forensic analysis of her soaked clothing by the FBI and US military revealed high levels of nicotine and the solvent DMSO.

Discussion: Nicotine has poor dermal absorption and the rapid development of toxicity from dermal exposures is exceedingly rare. In our case, the rapid evolution of a cholinergic toxidrome following the assault was concerning for an organophosphate or chemical nerve agent exposure, which led to the prompt and consequential involvement of law enforcement and the US military. Her clinical presentation, high urinary cotinine levels in a nonsmoker, forensic analysis of the patient's soaked clothing, and the pharmacodynamics of the poisoning suggested nicotine toxicity. Rapid nicotine absorption was abetted by the lipophilic aprotic solvent DMSO, which led to the accelerated development of systemic nicotine toxicity.

Conclusion: Systemic nicotine toxicity can present similar to organophosphate or nerve agent toxicity. Rapid development of severe nicotine toxicity from dermal exposures is rare and requires the presence of a lipophilic solvent to enhance absorption.

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214. Ingestion of methanol added to ethanol as an abuse deterrent

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Background: Despite the well-known toxicity, methanol outbreaks related to contaminated alcohol frequently occur. Contamination may result from poor distillation technique, intentional dilution, or more rarely, malicious intent. This is a report of an exposure after the intentional addition of methanol to ethanol as an abuse deterrent.

Case report: A 22-year-old male with a past medical history of alcohol use disorder presented to the emergency department after waking up heavily intoxicated. Per his father, the patient unknowingly drank 24 oz of vodka diluted with windshield wiper fluid which was intentionally added as an abuse deterrent by parents the night prior to presentation. Initially, the patient was altered, ataxic, hypertensive, and complained of visual disturbances. Initial labs were significant for a venous pH 7.17, HCO_3^- 9.0

mEq/L, anion gap 33.0 mEq/L, K 5.9 mEq/L, Cr 1.3 mg/dL and an undetectable ethanol level. He was subsequently transferred to a tertiary care hospital with dialysis capability. Fomepizole was started, and an initial methanol level resulted at 276 mg/dL. Patient underwent hemodialysis on hospital day 2, and leucovorin and folate were started. Repeat methanol resulted at 101 mg/dL. Two additional episodes of hemodialysis were performed on hospital day 2 and 3, and fomepizole was continued until methanol levels fell below 10 mg/dL, on hospital day 3. The patient was discharged home on hospital day 5 without complications.

Discussion: Although methanol exposures are well described in the literature, the intentional addition of methanol to ethanol as an abuse deterrent is rare. Our patient's clinical presentation, including an anion gap metabolic acidosis, intoxication, and reversible visual changes are classical findings associated with methanol toxicity. Although there was a delay to presentation, our patient was aggressively treated with fomepizole, folate, leucovorin and dialysis and his symptoms resolved relatively quickly. The public should be educated on the dangers of methanol and methods to seek help with alcohol use disorder.

Conclusion: We present a case with a unique circumstance of methanol exposure whose symptoms resolved quickly after aggressive intervention.

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215. Hospital referral rates for toddlers exposed to adult-strength, red, sweet-coated acetaminophen tablets

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Background/Objectives: Easy to swallow, red-coloured adult acetaminophen tablets (red-APAP) look and taste like candy. There is no requirement for child-resistant packaging. Some containers have a gear-shaped, toy-like lid. We sought to evaluate the association between exposure to red-APAP in children $\leq$5 years old and the need for hospital referral as well as the impact on treatment recommendations compared to other adult APAP tablet preparations (other-APAP).

Methods: Data from the Poison Centre database was extracted from November 16, 2019, to November 15, 2020, using product-specific coding for red-APAP and a generic code for other-APAP exposures in children $\leq$5 years old. Exposure histories for each case were manually reviewed to 1) identify APAP product coding errors and 2) confirm accidental exposure and 3) determine whether the child was referred to hospital for treatment (defined as N-acetylcysteine (NAC) administration or recommendation for decontamination with activated charcoal (AC)). Forty-seven red-APAP exposures were mistakenly coded as other-APAP, and three other-APAP exposures were mistakenly coded as red-APAP. Miscoded cases were manually reassigned to the correct APAP group. Cases from other provinces, duplicates or those with incomplete data were removed. Remaining data was limited to only adult APAP tablet formulations and single ingestions (co-ingestion with oral NSAIDs was permitted).

Pearson's Chi^2 test was performed for hospital referral rates outcome and the composite endpoint of treatment. Binary logistic regression was used to measure the association between red-APAP exposure and the odds of each outcome, reported as unadjusted odds ratios (ORs) with 95% confidence intervals. Analyses were performed using R version 4.0.3.

Results: In this 1-year period, a total of 51, 018 exposure calls were received with 16, 523 (32.4%) involving accidental exposures in children $\leq$5 years old. In this age group, 427 (2.6%) exposures involved adult APAP tablet formulations with 244 (57%) involving red-APAP exposures. The hospital referral rate in the red-APAP versus the other-APAP group was 48% versus 35%, respectively (OR 1.71 [1.12, 2.64]) $p = 0.02$). Composite endpoint (NAC given or AC recommended) occurred in 41% (100/244) versus 29% (53/183) of red-APAP versus other-APAP groups, respectively (OR 1.70 [1.14, 2.57], $p = 0.014$). NAC was administered in 4 and 2 children exposed to red-APAP and other-APAP, respectively. Red-APAP and other-APAP mean 4-hour APAP levels (when available) were 2343 umol/L and 1320 umol/L, respectively. No cases of hepatoxicity (AST >1000) occurred. Potential weaknesses of this study include the usual Poison Centre data limitations, including misclassifications, retrospective design, and a potential bias for referring children to hospital with red-APAP exposures.

Conclusions: Based on available data, the majority of adult-strength acetaminophen tablets exposure in toddlers seems to involve red-APAP. We identified a significant association between red-APAP exposure and higher rates of hospital referral compared to other-APAP adult tablet preparations. Red-APAP exposures are also associated with more frequent treatment recommendations. Contributing factors such as a candy-like appearance, taste and container design should be explored further for this vulnerable pediatric population.

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216. Pediatric jellyfish envenomation in the Mediterranean Sea

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Background: Several species of jellyfish native to the western Indian Ocean have entered the Mediterranean Sea through the Suez Canal. Since the late 1980s, each summer Rhopilema nomadica forms swarms as long as 100 km in the southeastern Levant and since the millennium aggregations of additional nonnative jellyfish have been sighted. The aim of this study was to evaluate children seen in the emergency department after jellyfish envenomations and to establish patterns of toxicity associated with this organism.

Methods: A retrospective chart review was performed of all children presenting after jellyfish envenomations to the pediatric emergency department during the jellyfish swarming seasons (June-August) between 2010 and 2015. Extracted data included age, location of envenomation, pain scores, local and systemic manifestations, treatment provided in the emergency department and hospital, and disposition.

Results: Forty-one patients fulfilled the inclusion criteria; their ages ranged from 1 to 16 years and the median age was 9.4 years. Clinical manifestations were evident in all patients. Pain, present in 100% of patients, and an erythematous, whip-like, linear rash present in 87.8%, were the most common manifestations. The majority of 'burns' associated with jellyfish stings were first and second degree. The upper limb was affected in 34% and the lower limb was affected in 61% of cases. One patient suffered a sting to the abdomen and three patients suffered a sting to the face. Treatment in the emergency department included pain control, with nonsteroidal anti-inflammatory drugs and opiates, and antihistamines and topical corticosteroids in some cases. Nearly 49% of patients were seen during the summer of 2015 alone and seven patients in this group needed hospitalization. Reasons for hospitalization included systemic symptoms such as fever, chills, tachycardia, and muscle spasms. Two patients developed severe cellulitis, one patient had an anaphylactic reaction, and one was admitted to the ICU after suffering an anaphylactic reaction to a sting sustained while surfing.

Conclusion: The prevalence of the jellyfish swarms and the severity of clinical manifestations because of their envenomations suggest that it should be considered as a health hazard in the Mediterranean Sea. We call for public health authorities in affected countries to initiate a health hazards database, familiarize medical and healthcare staff with the clinical syndromes, train medical and healthcare staff in appropriate treatment, and initiate and continue public awareness campaigns.

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217. Evaluation of antivenom therapy for *Echis coloratus* envenomations in children: experience of two large tertiary care pediatric hospitals

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Background: Antivenom has been used successfully to treat systemic and progressive local manifestations of envenomations inflicted by Echis coloratus, the second most common cause of snake envenomation in Israel. This study describes the epidemiology and clinical manifestations of Echis coloratus envenomation in Israeli children, and evaluates the fixed-dose Echis coloratus monovalent (equine) immunoglobulin G antivenom regimen used in two large, tertiary care pediatric centers.
Methods: A retrospective chart review of children admitted with definite or probable signs of Echis coloratus envenomation to Sourasky (Tel Aviv) and Soroka (Beer Sheva) Medical Centers between January 1st 2008 - June 1st 2019. Extracted data included: age, location of bite, time to hospital arrival, laboratory test results, complications, time to antivenom administration if indicated, adverse effects of the antivenom, and outcomes. Indications for antivenom were: diagnosis of Echis coloratus as the etiology of envenomation, local and systemic signs e.g. skin puncture wounds, swelling of the involved limb, local hematoma, and abnormal coagulation blood test results.
Results: During the study period, 11 children were treated with intravenous Echis coloratus antivenom. Median age was 9 years, with a male preponderance (90.9%). Two patients underwent fasciotomy; in one, compartment syndrome was diagnosed by pressure measurement, and in the second, clinically. One patient developed mild urticaria 30 minutes after initiation of the antivenom; the treatment was stopped and then restarted at a slower rate after he was treated with hydrocortisone and diphenhydramine. No further adverse reactions were observed.
Conclusions: In children, Echis coloratus antivenom is efficacious and safe for the treatment of systemic and progressive local manifestations of envenomation by Echis coloratus.

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218. Nail polish remover exposures treated at emergency departments

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Background: Nail polish remover is an organic solvent used to remove nail polish. The most common nail polish remover solvent is acetone, although other chemicals such as ethyl acetate and isopropyl alcohol may be used. When ingested, acetone may cause central nervous system and respiratory depression, hyperglycemia, and ketonemia. The objective of this study was to describe nail polish remover exposures managed at United States (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. In order to identify nail polish remover exposures reported during 2000-2019, records with the letter combinations "nail," "rem," and either "pol" or "varn" in the record narrative were reviewed, and those that appeared to be nail polish remover exposures were included in the study. The distribution of estimated nail polish remover exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.
Results: A total of 460 nail polish remover exposures were identified, resulting in a national estimate of 14,040 exposures. The nail polish remover was stated to contain acetone in 2,732 (19.5%), not contain acetone in 712 (5.1%), and unknown in 10,595 (75.5%). By four-year period, there were 2,580 (18.4%) exposures during 2000-2003, 2,952 (21.0%) during 2004-2007, 3,307 (23.6%) during 2008-2011, 3,151 (22.4%) during 2012-2015, and 2,049 (14.6%) during 2016-2019. The patient age distribution was 13,435 (95.7%) 0-5 years, 102 (0.7%) 6-12 years, 315 (2.2%) 13-19 years, and 187 (1.3%) 20 years or older; 7,006 (49.9%) of the patients were male and 7,034 (50.1%) female. The patient race was 5,921 (42.2%) white, 2,363 (16.8%) black/African American, 1,972 (14.0%) other, and 3,783 (26.9%) not stated. The exposure route was 11,918 (84.9%) ingestion, 1,247 (8.9%) ocular, 786 (5.6%) dermal, 431 (3.1%) inhalation, and 68 (0.5%) unknown. The reported location where the exposure occurred was 10,706 (76.3%) home, 161 (1.1%) other public property, 6 (0.0%) street or highway, and 3,167 (22.6%) not recorded. The most commonly reported clinical effects were 1,284 (9.1%) vomiting, 744 (5.3%) chemical burn, 482 (3.4%) conjunctivitis, 349 (2.5%) cough, and 231 (1.6%) foreign body. The patient disposition was 13,120 (93.4%) treated or examined and released, 33 (0.2%) treated and transferred to another hospital, 285 (2.0%) treated and admitted for hospitalization, 254 (1.8%) held for observation, and 348 (2.5%) left without being seen/against medical advice.
Conclusion: Nail polish remover exposures treated in EDs most often involved patients who were children age 0-5 years. The majority of exposures occurred by ingestion followed ocular and dermal contact. Most patients were treated or evaluated and released from the ED.

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219. Self-harm attempt statistics by transgender people are not accurately captured by poison centers

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Objective: Society is made up of a diverse gender population. A 2021 Gallup poll reported that 5.6% of adults in the United States self-identify as lesbian, gay, bisexual, or transgender. According to the Center for Disease Control and Prevention (CDC), transgender people make up 0.6% of the population in the United States (U.S.). An article published in Psychology Today reported that transgender people attempt suicide 10 times the

rate of their cisgender (identify with their gender at birth) counterparts. Poison Centers (PC) place emphasis on exposure management, coding, and accurate data collection. Data collected from Poison Centers are used by researchers, social services, and medical personnel to help facilitate better health care services. Tools used to identify gender identity in patient's charts, surveys, and/or questionnaires rarely ask the person's gender identity beyond male, female, or unknown. PCs gender identification drop down list only includes males, females, or unknown. Transgender self-harm overdose cases are only documented as such when PC staff adds the word transgender or characteristics identifying the person as a transgender person in the chart's notes and only if gender identity is addressed during the consultation period. The objective of this research is to determine if self-harm overdoses by transgender people are documented by the PCs under review at the same rate as their cisgender counterparts

Methods: We conducted a retrospective data review from 11% of the 55 Poison Centers in the U.S., over the last decade and compared documented cases of self-harm poisoning for cisgender to their transgender counterparts.

Findings: In the last decade, a total of 129 self-harm cases involving transgender people have been documented by the six PCs under review. The total amount of self-harm cases documented by the same six PCs during the same period of time was 198.566. Transgender cases made up 0.000649% of the cases during the same researched time period.

Conclusions: Theoretically, more than 11,910 cases involving transgender people attempting suicide by drug overdose should have been captured by PC staff. Tools used to document the person's gender identity should be upgraded to be more inclusive. Precise data collection will help researchers, social services and medical personnel help facilitate better health care services through accurate data collection.

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220. Expanding intracranial hemorrhage after administration of andexanet alfa

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Background: Andexanet Alfa is the only FDA-approved agent-specific reversal for the treatment of life-threatening bleeding associated with use of oral factor Xa inhibitors (FXa inhibitors). Current guidelines provide little preference for Andexanet Alfa over alternative therapies, such as four-factor prothrombin complex concentrate (4F-PCC), in management of life-threatening bleeds. The ANDEXXA-4 trial study design excluded many patients including those with needing surgery within 12 hours. Management of patients failing Andexanet Alfa or needing emergent surgery where the addition of 4F-PCC is lacking from the literature. Adverse events of combination treatment are equally lacking and thrombotic complications would presumably be higher. We present two case reports of patients receiving Andexanet Alfa, where bleeding control was not obtained or patients required urgent surgical intervention requiring additional treatment with 4F-PCC.

Case report: The first case is an 86-year-old female with a history of hypertension, anxiety, and atrial fibrillation, anticoagulated with Apixaban. A computed tomography scan revealed multifocal left-sided intracranial hemorrhage (ICH) in the frontal, temporal and parietal lobes. Due to the timing of the last apixaban dose the patient was given the low dose of Andexanet Alfa 400 mg bolus, followed by infusion of 4 mg/minute for 120 minutes. Repeat six-hour CT scan showed expanding ICH. Anti-factor Xa activity calibrated for Low-molecular-weight heparin levels were $\geq$2 IU/mL indicating apixaban activity was still present. Due to increasing ICH despite Andexanet Alfa therapy, it was elected to administer 4F-PCC 28 units/kg. Repeat CT scan 4 hours after 4F-PCC halted progression of ICH with no significant change in the size of the hemorrhage.

The second case is a 62-year-old male with a past medical history of hypertension and atrial fibrillation anticoagulated with apixaban. CT scans showed moderate to large volume of bilateral supratentorial and infratentorial subarachnoid hemorrhage, with intraventricular hemorrhage and hydrocephalus. Due to the timing of the last apixaban the patient was given Andexanet Alfa 400 mg bolus, followed by an infusion of 4 mg/minute for 120 minutes. The patient was taken for external ventricular drain placement. Due to lack of data on the use of Andexanet Alfa in urgent surgical cases patient was administered 4F-PCC 50 units/kg before intervention.

Discussion: There have been several studies comparing the effectiveness and outcomes of Andexanet Alfa compared to 4F-PCC as initial therapies in the setting of an ICH. A recent study by Ammar et al., investigated Andexanet Alfa versus 4F-PCC for reversal of FXa inhibitors in ICH and found no difference of hematoma expansion as defined as hematoma volume at six and 24 hours. Barra and colleagues found in a retrospective, single-centered study Andexanet Alfa had a higher percentage of excellent or good homeostasis and good functional outcome at discharge when compared to 4F-PCC.

Conclusion: Minimal guidance is available regarding therapy failures or cases of combined therapy with Andexanet Alfa and 4F-PCC. Limitations to the ANDEXXA-4 trial design leaves questions around patients requiring emergency surgeries. We present two case reports of patients receiving Andexanet Alfa and 4F-PCC where no additional side effects or thromboembolic events were noted for either patient.

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221. Physostigmine reversal of delirium from second generation antipsychotics: a retrospective cohort study from a regional poison center

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Background: While physostigmine is an effective treatment for drug-induced delirium from traditional antimuscarinic medications (such as first-generation antihistamines), it has also been reported to reverse the delirium following overdose of second generation antipsychotics (SGAs), particularly those with antimuscarinic properties, such as quetiapine. The evidence for such practice, however, is limited primarily to case reports and small series. The purpose of this study is to describe the effectiveness and safety of physostigmine in reversing delirium from SGA poisoning.

Methods: This is an IRB-exempted retrospective cohort study of all patients reported to a single regional poison center for whom physostigmine was administered following exposure to an SGA

from 1/1/2000 to 4/15/2021. The poison center's electronic medical record (Toxicall©) was queried for any exposure cases involving an SGA (AAPCC code: 201122) where "physostigmine" was coded as "performed whether or not recommended." The primary outcome measure was whether there was a positive response to physostigmine (coded as yes or no), determined by a trained abstractor who reviewed case notes for every patient. Secondary outcomes included physostigmine dosing and adverse events.

Results: Data query returned 147 charts, comprising 138 individual patients, 122 of which were treated since 2015. The most common SGA was quetiapine (n = 97, 70%), followed by olanzapine (n = 27, 20%). A positive response to physostigmine was noted in 106 cases (82%; 95% CI: 75 - 89%). Median number of physostigmine doses was 1 (IQR: 1 - 3, range 1 - 9). Median total physostigmine dose received was 2 mg (IQR: 2 - 6, range 0.15 - 30). Characteristics of physostigmine dosing and effectiveness stratified by SGA are reported. Regarding co-ingestions, 92 patients co-ingested another substance; of these patients 37 co-ingested a drug with antimuscarinic properties. The physostigmine response rate for patients with an antimuscarinic co-ingestion was not significantly different (26/37, 70%, [p = 0.4, chi-square]) than the total study cohort. Adverse events were rare. One patient suffered a cardiac arrest after physostigmine. This patient had schizophrenia and had been hospitalized for over one month, whereupon he developed hospital-acquired delirium in the setting of increasing clozapine dosing. Bedside consultation was consistent with antimuscarinic delirium. He received physostigmine resulting in resolution of delirium, however, 30 minutes later delirium recurred and the patient was intubated. Twenty minutes after intubation (one hour after physostigmine), the patient suffered a bradyasystolic cardiac arrest. Documentation from the attending medical toxicologist noted the arrest was unrelated to physostigmine.

Conclusions: In this study, physostigmine was an effective treatment for antimuscarinic delirium owing to second generation antipsychotic poisoning (primarily from quetiapine and olanzapine), with a positive delirium reversal rate similar to general use physostigmine studies. Adverse events associated with physostigmine were infrequent. Physostigmine appears to be a safe and effective treatment for antimuscarinic delirium from second generation antipsychotic poisoning. More studies are needed to validate these findings.

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222. Cannabis associated nonadherence leads to increased cannabis associated seizures: an observational study

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Background: Liberalization of recreational cannabis in Colorado in 2014 led to increased cannabis use. It is known that some patients with epilepsy use cannabis for the treatment of their seizure disorder as an alternative to antiepileptic drugs (AEDs). It is currently unknown how the use of cannabis relates to seizure-related emergency department (ED) visits and rates of medication nonadherence.

Methods: This was a retrospective observational study based on chart review of patients presenting to the ED of an urban academic hospital. All ED visits from 1 January 2012 through 31 December 2016 were eligible for inclusion. Visits that contained an International Classification of Diseases, Ninth or 10th Revision, Clinical Modification (ICD-9-CM or ICD-10-CM), code consistent with cannabis exposure were manually reviewed. All ICD-9-CM or ICD-10-CM codes for seizure-related diagnoses and medication nonadherence were also manually reviewed for the comparator group. Patients eighteen years or older with an ED visit containing a cannabis-related ICD-9-CM or ICD-10-CM code were included. A visit was considered at least partially attributable to cannabis if one or more of the following criteria were met: 1) the ED provider identified cannabis as likely precipitating or contributing to the condition, 2) the patient was admitted to the hospital and the inpatient provider identified cannabis as likely precipitating or contributing to the condition, or 3) the urine toxicologic screening result was positive and there was a documented temporal relationship (within approximately 24 hours) with cannabis exposure and there was a condition or an event known to be associated with cannabis use. Cannabis-attributable nonadherence (CAN) was defined as use of a cannabis product in place of prescribed AEDs. General nonadherence (GN) was defined as nonadherence to AEDs unrelated to cannabis use. Total nonadherence (TN) was defined as general nonadherence plus cannabis attributable nonadherence.

Results: There were 2567 cannabis-attributable ED visits in this five-year period. Of the cannabis-attributable visits, there were 50 visits (1.9%) where seizure was documented. Seventeen of these visits were excluded due to use of synthetic cannabinoid, diagnosis of seizure excluded our doubted by ED provider, alternative diagnosis more likely than seizure or an alternative exposure/diagnosis was more likely the etiology of seizure. Thirty-three visits (1.2%) where seizure was documented were included and the diagnosis of seizure was determined by pre-hospital details, evaluation by ED provider, neurology consultation and/or admitting providers. Cannabis-attributable seizures (CAS) accounted for 2.6% of total seizure-related ED visits in 2016, an increase of 2.6% during this five-year study period. A third of the CAS (33.3%) were related to nonadherence secondary to cannabis use. From 2014 - 2016, the percent of seizure-related ED visits attributed to CAN increased by 1.6%. ED seizure-related visits secondary to GN declined by 2.7% from 2014 to 2016.

Conclusion: The percent of total ED visits related to CAN increased since 2014 whereas GN has decreased since 2014. This inflection point corresponds to the year in which cannabis became commercially available for recreational use. CAS are increasing and substitution of cannabis for antiepileptics is a major contributor to this phenomenon.

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223. This is the way?: Practice patterns in the management of serotonin syndrome and utilization of cyproheptadine

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Background: Serotonin syndrome (SS) is often described as a clinical triad of mental-status changes, autonomic instability, and neuromuscular abnormalities. The incidence of SS has been on the rise, in concordance with the increase in serotonergic pharmaceuticals being recently approved. Currently, there are no guidelines or consensus recommendations for the diagnosis or management of serotonin toxicity. When managing SS, treatment is focused on symptomatic and supportive care, including active cooling and benzodiazepines in addition to removal of the precipitating xenobiotic. Cyproheptadine is an antihistamine

possessing 5-HT_{2A} antagonist properties that has been utilized in case reports and case series with variable effect. There are no consensus recommendations on dosing, frequency, or duration of therapy. The goal of this study is to identify practice variations in the diagnosis and management of SS, including the use of cyproheptadine, among healthcare professionals working in the field of toxicology.

Methods: This was an IRB-approved cross-sectional survey conducted from April 21st, 2021 to May 19th, 2021. Members of the American Academy of Clinical Toxicology (AACT), consisting of physicians, pharmacists, and specialists in poison information (SPIs) trained in the field of toxicology, were emailed a 21-question survey regarding their practices in the management of SS and utilization of cyproheptadine. Participation in the survey was both optional and anonymous. Responses to each question were recorded and analyzed using descriptive statistics.

Results: Of the 700 AACT members sent a survey, 168 responded (24%). When diagnosing serotonin syndrome, 58% of respondents rely on clinical presentation, while 40% utilize the Hunter criteria. Ninety-seven percent of respondents utilize benzodiazepines as first-line, and 13% of respondents utilize cyproheptadine first-line. When utilizing cyproheptadine, only one respondent would not utilize benzodiazepines concomitantly. The most common starting dose of cyproheptadine was 9-12 mg (39%) followed by 5-8 mg (31%). The most common maintenance dosing strategy was 4 mg every 6 hours until symptoms resolve. Seventy-four percent of respondents do not utilize cyproheptadine for a specific duration of therapy and 82% do not utilize cyproheptadine for a specific total dose. A majority of respondents consider the evidence for cyproheptadine in SS to be of poor quality (56%), while only 17% of respondents consider the evidence of at least good quality.

Conclusions: Practice patterns in the overall management of SS may not vary a great deal in the field of toxicology. There is considerable variation in the utilization of cyproheptadine including initiation, dosing, duration, and endpoints of therapy. Most respondents are of the belief that the evidence for cyproheptadine is poor. Based on the results of this survey and the minimal data available regarding the use of cyproheptadine, further prospective research to clarify the utility of cyproheptadine in the management of serotonin toxicity is warranted; the mainstay of treatment remains symptomatic and supportive care.

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224. Rebound salicylate toxicity following discontinuation of sodium bicarbonate infusion

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Background: Management of salicylate toxicity frequently requires intravenous alkalization to achieve urinary alkalization and enhance excretion of ionized salicylate. While not standardized, alkalization generally continues until a patient demonstrates two consecutive sub-toxic levels below 30 mg/dl. When alkalization ceases, a rebound in serum salicylate level may occur from tissue redistribution and salicylate's erratic absorption and elimination profile. The purpose of this study is to analyze the incidence of salicylate rebounding to a level deemed toxic after discontinuation of a sodium bicarbonate infusion.

Methods: This was a single-center, retrospective study of patient cases with a primary ingestion of salicylate reported to the Wisconsin Poison Control Center from January 1st, 2015 through December 31st, 2019. Cases were excluded if the salicylate product was not listed as the primary ingestion, or if there was no salicylate level documented after discontinuation of sodium bicarbonate infusion. A rebound salicylate level was defined as any increase in salicylate level after discontinuation of bicarbonate infusion compared to the previous level recorded prior to stopping the infusion. Salicylate toxicity was defined as a salicylate level above 30 mg/dl. The primary outcome was the incidence of rebound salicylate toxicity following discontinuation of sodium bicarbonate infusion.

Results: During this five year period, 512 salicylate cases were reviewed. Of these cases, 135 did not have a documented salicylate level after the bicarbonate infusion was discontinued and were excluded. Of the 377 remaining cases, eight (2.1%) had a rebound salicylate level after stopping the bicarbonate. These cases were all acute ingestions. The median time from sodium bicarbonate infusion discontinuation to repeat level was 2 hours, 59 minutes (IQR 3 hours, 33 minutes), with only three cases having repeat levels checked four hours or more after ending the bicarbonate infusion. One patient reported new tinnitus at time of their rebound salicylate level. All other patients remained asymptomatic. Six patients had bicarbonate infusions restarted due to a rebound salicylate level. Five of the eight cases had rebound toxic salicylate levels; all of these cases had levels between 20 – 30 mg/dl immediately prior to stopping the infusion, and two of the five cases had only one salicylate level below 30 mg/dl prior to shutting off the infusion. Therefore, only three cases (0.8%) had rebound salicylate toxicity following discontinuation of the bicarbonate infusion if two consecutive subtoxic levels were obtained prior to stopping it.

Conclusions: Overall, the incidence of salicylate rebound is low, and one salicylate level below 30 mg/dl prior to bicarbonate infusion discontinuation may suffice. This is limited to being a single-center, retrospective review and was reliant on only the documentation within the Wisconsin Poison Control Center database.

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225. Clinical characteristics and outcomes using dexmedetomidine in non-intubated patients, a poison center observational study

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Background: Dexmedetomidine is a central alpha-2 agonist that is increasingly being used off-label as an adjunctive sedative for agitated toxicology patients. Dexmedetomidine does not interact with the gamma-aminobutyric acid (GABA) receptor and ideally would be less likely to induce deep sedation resulting in intubation and mechanical ventilation. However, because of its alpha-2 agonism, it can lead to bradycardia and hypotension. Little is known about the clinical outcomes of dexmedetomidine use in agitated toxicology patients. We sought to determine the overall clinical course, adverse drug effects, and need for subsequent mechanical ventilation after use of dexmedetomidine.

Methods: This was a retrospective cohort study conducted by chart review of electronic records from the Virginia Poison Control Center from January 1, 2019 to March 12, 2021. Inclusion criteria consisted of all poison center cases where dexmedetomidine was used. Cases were excluded if patients were intubated prior to the start of dexmedetomidine infusion or if there was missing data. The primary outcome was the presence or absence of clinical improvement following dexmedetomidine use. Clinical

improvement was determined based on narrative review and abstractor consensus. Secondary outcomes included adverse effects, subsequent intubation, or deaths.
Results: During this study period, there were 68 cases in which dexmedetomidine was used to treat agitation. Patients who were intubated prior to the start of dexmedetomidine (n = 40) and cases with missing data (n= 7) were excluded, leaving 21 cases for analysis. The median age was 35 (IQR 16, 48) and 52% (n= 11) were female. Poisoning etiology included polysubstance (n= 5), unknown (n= 3), anticholinergic (n= 3), sympathomimetic (n =3), hallucinogenic (n= 2), sedative withdrawal (n = 4) and antipsychotic (n= 1) exposures. Overall clinical improvement occurred in 17 of 21 patients (81%). There were no deaths and no patients required cardiopulmonary resuscitation. One patient with possible baclofen withdrawal required subsequent intubation for refractory agitation and one patient had transient oversedation.
Conclusions: Dexmedetomidine use resulted in clinical improvement with few documented adverse effects in most patients. There were no cases of intubation due to oversedation. Limitations of this study include small sample size. Dexmedetomidine could be a useful adjunct treatment for agitated toxicologic patients and should be studied further.

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226. Efficacy and safety of glucagon for the management of beta blocker toxicity

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Background: Although glucagon use in beta blocker toxicity has been recommended for many years, at the time of our evaluation evidence for its efficacy was limited to animal trials and case reports that showed consistent improvement in heart rate following administration without discussion of side effects. This study aimed to enhance the existing knowledge base regarding the safety and efficacy of glucagon use for treatment of bradycardia related to beta blocker toxicity.
Methods: We conducted a retrospective, multi-center cohort study of patients greater than 12 years of age who received glucagon for beta blocker toxicity. Patients receiving atropine concomitantly, or in the five minutes prior to glucagon administration were excluded. The primary outcome was the mean difference in heart rate (HR) from immediately pre- to 20-minutes post-glucagon administration. Secondary outcomes included: difference in median systolic blood pressure (SBP) from immediately pre- to 20 minutes post-glucagon administration, incidence of nausea and vomiting, and incidence of hyperglycemia. The percentage of patients whose bradycardia and SBP improved post-glucagon administration were also examined as secondary outcomes. For the primary outcome, a two-sided paired t-test was used to evaluate the mean difference in heart rate. The difference in median systolic blood pressure was evaluated using a Wilcoxon Signed-Rank test as a secondary endpoint. The remaining secondary outcomes are reported as descriptive statistics. A pre-specified sensitivity analysis was conducted for outcomes related to heart rate and blood pressure to assess for confounding secondary to administration of vasopressors.
Results: Between January 1, 2013 and December 31, 2019 a total of 107 patients met inclusion criteria and 144 orders for glucagon were analyzed as several patients received multiple administrations. Of all administrations, 46 (31.9%) were for confirmed overdoses, 37 (25.7%) were intentional, and 64 (44.4%) were for polysubstance exposures. For the primary outcome, the mean increase in heart rate from pre- to post- glucagon administration was 4 bpm ±10.6 (95% CI: 2.25 to 5.76, $p < 0.001$). The median systolic blood pressure was 101.5 [85.25 – 130] pre-glucagon administration, and 109.5 [93 – 133] post-glucagon ($p = 0.004$). Similar increases in HR and BP were observed in a subgroup of 123 patients who did not receive concomitant vasopressors. HR increased by ≥10 bpm in 34 patients (23.6%), and SBP increased by ≥20 mmHg in 29 patients (20.1%). A total of nine glucagon administrations (6.3%) were associated with nausea and 14 (9.7%) with vomiting; however, 52 doses (36.1%) were administered concomitantly with antiemetic medications. Fifteen administrations (10.4%) were associated with hyperglycemia.
Conclusion: Statistically significant increases in HR and SBP were observed with the use of glucagon for beta blocker toxicity; however, the absolute differences were small. A low number of patients experienced adverse events from glucagon use which supports overall safety.

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227. February 2021 winter storm results in changes in exposures reported to Texas poison centers

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Background: On February 14-15, 2021, a winter storm and cold wave caused heavy snowfall and record cold temperatures in Texas. As power generation facilities shut down and demand for electricity overwhelmed the electric grid system, rolling outages were initiated at 1:25am on February 15, 2021. More than 4 million people in Texas lost power. People were without electricity and heat for days. Water pipes and water mains burst, producing low water pressures and this, combined with the power outages, disabled water treatment plants. As a result, 12 million people in the state were subject to boil water advisories. In an effort to keep warm, many people brought charcoal and gas grills indoors, ran vehicles in enclosed spaces, or incorrectly used portable generators, exposing themselves and others to carbon monoxide (CO). Gasoline exposures were also experienced, as was food poisoning. The objective of this study was to characterize selected exposures reported to Texas poison centers in the two weeks after the power outages.
Methods: Cases were carbon monoxide, food poisoning, and gasoline exposures reported to the Texas Poison Center Network during five time periods: 2/15/21-2/28/21 (storm and storm effects period), 2/1/21-2/14/21 (immediate pre-storm period), 3/1/21-3/14/21 (post-storm effects period), 2/15/19-2/28/19 (two years pre-storm), and 2/15/20-2/28/20 (one year pre-storm).
Results: See chart for exposure count results. Of the 512 carbon monoxide exposures reported during 2/15/21-2/28/21, the patient age distribution was 87 (17.0%) 0-5 years, 85 (16.6%) 6-12 years, 50 (9.8%) 13-19 years, 54 (10.5%) 20-29 years, 64 (12.5%) 30-39 years, 46 (9.0%) 40-49 years, 47 (9.2%) 50-59 years, 38 (7.4%) 60 years or older, and 41 (8.0%) unknown age; 271 (52.9%) of the patients were female, 235 (45.9%) male, and 6 (1.2%) unknown sex. The exposure site was 483 (94.3%) patient's own residence, 18 (3.5%) other residence, and 11 (2.1%) other or unknown locations. The patient was already at or en route to a healthcare facility in 299 (58.4%) of the exposures, referred to a healthcare facility in 78 (15.2%), managed on site (outside of a healthcare facility) in 124 (24.2%), and at other or unknown

locations in 11 (2.1%). The patient was reported to have died in 4 (0.8%) cases.
Conclusion: The Texas Poison Center Network saw a large increase in carbon monoxide exposures immediately after the power outages began. Food poisoning and gasoline exposures also increased after the power outages.

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228. Outpatient management of a high-risk rattlesnake envenomation during the COVID-19 pandemic

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Background: Patients sustaining rattlesnake envenomation are typically treated in the hospital. During the Covid-19 pandemic, crisis standards of care were implemented in our state. We present a case of rattlesnake envenomation treated effectively as an outpatient after receiving antivenom in the emergency department. This case is also unique in that the patient was envenomated while swimming in a pool.
Case report: A healthy 70-year-old man presented to the Emergency Department following a rattlesnake bite to the right upper back. While swimming in his pool, he felt a "twinge" and then observed a small rattlesnake in the water next to him. On presentation to the ED, he had two punctures and induration measuring 8cm x 10cm overlying the upper back and extending toward the posterior shoulder. He had minimal pain. Labs revealed a platelet count of 144, fibrinogen of 184, and INR 1.0. Given the local effects and his mild thrombocytopenia, 10 vials of Anavip® [crotalidae immune F(ab')2 (equine)] were administered. Repeat labs showed a platelet count of 204, fibrinogen of 117, and INR 1.2. Admission was recommended for continued monitoring, but the patient requested to be discharged home. Through shared decision making, the patient was offered additional antivenom and close follow up in the ED. An additional 10 vial dose of Anavip® was administered. Labs obtained prior to discharge demonstrated improvement in hematologic venom effects. He returned to the ED later that day for re-evaluation. There was no progression of induration, and labs were improved. He had developed extensive, patchy ecchymosis over the bite site, involving the posterior axilla and posteromedial arm. Pain remained mild, and he did not require opioids. He was released with instructions for outpatient labs in 7 and 14 days to evaluate for recurrent coagulopathy. He declined lab testing but reported improvement of local effects and was back to normal two weeks after his envenomation.
Discussion: Although Covid-19-related hospitalizations in our region had been declining over the 9 weeks prior to his presentation, this patient was cognizant of hospital resources and a theoretical risk of nosocomial exposure to SARS-CoV-2. In light of his mild symptoms and proximity to medical care, we felt he was a candidate for outpatient management with close follow up. Consensus guidelines recommend hospitalization for serial examinations and laboratory studies during the 18-24 hours after control of envenomation is achieved. Venom effects can recur up to 10 days after initial control, and the optimal duration of hospitalization after envenomation has not been formally studied. Although he was non-adherent with discharge instructions, he continued to improve clinically and had no evidence of bleeding complications. Additionally, his envenomation occurred in a swimming pool, which has not been reported in the literature, although articles in the lay press have described rattlesnakes in and around pools in our area.
Conclusions: Outpatient management of rattlesnake envenomation in carefully selected patients is feasible. During a pandemic, outpatient management may be preferable when appropriate. Rattlesnakes may strike and bite even in water.

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229. Association of rattlesnake bites close to human-made structures and temperature drop

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Background: Rattlesnake envenomations continue to be a disease of clinical importance in the Southwestern United States. Attempts have been made to predict snake behavior in relation to ambient temperature in order to predict the potential burden of rattlesnake bites during their active season. Ambient temperature, humidity, and animals' body temperatures have been used as surrogates to predict rattlesnake activity, including interactions with humans. Thus far, only increased body temperature has been correlated with increased rattlesnake activity. Changes in ambient temperature have not been shown to be associated with an increase in incidence of envenomation in the Southwest US. We hypothesize that sporadic sudden drops in temperature at night during the season of highest rattlesnake activity correlate with shelter-seeking behavior of rattlesnakes resulting in increased rattlesnake bites in close proximity to human-made structures.
Objective: Determine if there is a correlation between sporadic sudden drops in temperature at night and shelter seeking behavior of rattlesnakes leading to increased rattlesnake bites occurring in proximity to human-made structures. Determine if these bites occur more frequently on upper or lower extremities.
Methods: We retrospectively reviewed a regional poison center's database for all snakebites in the months of March through November for the years 2017-2020. We analyzed all cases that occurred in humans between the ages of 2 to 75 years. Dry bites were excluded. Each case was reviewed for circumstance of the bite, time of day, proximity to a human-made structure, and anatomic location of the bite. Key words such as "stepping outside", "stepping outside the car", "entering a building", or any similar phrases were used as surrogates for proximity to human-made structures. Temperatures were obtained from the National Oceanic and Atmospheric Administration website for the National Centers of Environmental Information's weather stations and daily high and low temperatures were evaluated for sudden drops matched with each case's zip code. Sporadic sudden temperature drop was defined as a decrease of greater than 20 degrees Fahrenheit, which exceeds the average day to night temperature decline during the "snakebite season". Night was defined as the hours from 18:00 to 06:00.
Results: 604 cases of rattlesnake bites were identified. Of these, 216 met the temperature criteria and occurred at night. 45 (21%) envenomations occurred in close proximity to a human-made structure, and 37 (82%) of these occurred on a lower extremity. 388 additional bites either did not meet the temperature criteria or did not occur at nighttime. 50 (12%) envenomations occurred in close proximity to a human-made structure, and 41 (82%) of these

occurred on a lower extremity. The odds ratio for an envenomation occurring near a human-made structure during a time of a sporadic sudden temperature drop was 1.78, suggesting an increase in risk of envenomation for humans under these circumstances.
Conclusions: There is a positive association between sporadic sudden temperature drops and rattlesnake envenomations in proximity to human-made structures.

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230. Identifying risk factors for severe outcomes in metformin poisoning

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Objectives: Metformin associated lactic acidosis is a serious consequence of acute or chronic metformin poisoning. Mortality is high and critical interventions such as dialysis, vasopressors, intubation, and mechanical ventilation may be required. Risk factors of severe cases remain ill-defined. The primary objective of this study was to identify factors associated with the composite of kidney replacement therapy (KRT) or mortality in metformin poisonings. The secondary objective is to characterize moderate, major, and fatal poisonings from metformin.
Methods: This was a retrospective case-control study of metformin exposures from January 2010 to November 2020 reported to two regional poison centers. Patients were included if outcomes were coded as major, moderate, and death. Exposures with metformin-combination products were excluded. Cases were defined as those meeting the composite endpoint of death or receiving KRT; the remaining exposures were controls. All data coded into the poison center chart was validated via manual data extraction and compared with case narratives regarding lab values, times of exposures, and clinical effects. Odds ratios were performed to measure the strength of the association between a risk factors and the composite outcome.
Results: Two-hundred and sixty-five patients (51.1% male) were included with 59 (22.3%) resulting in death or requiring KRT. Those who died were older; 54.3 vs 46.4 years (95% CI, -12.56 to -3.22). KRT was performed in 45 (17%) individuals and a total of 24 died. KRT was performed in 11 of the 24 that died. The majority of exposures were acute (135, 51%), followed by acute-on-chronic (87, 33%). Chronic exposures were more likely to result in KRT or death than acute, acute-on-chronic, or unknown chronicity ($p = 0.022$). The mean initial lactate was 13.4 mmol/L in those who died or received KRT vs 4.2 mmol/L in those who did not. An initial lactate $\geq$10 mmol/L was associated with an increased risk of KRT or death.
Conclusion: Increased age, elevated lactate, and chronic exposures are independent risk factors positively associated with an increased likelihood for need of KRT or mortality in metformin poisonings. Expeditious recognition of these factors early on in clinical presentation may assist in early treatment recommendations for metformin poisoning.

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231. Description of beta-blocker overdosage information in package inserts

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Background: Package inserts (PIs) contain drug information for prescribing healthcare professionals and are enforced by the Food and Drug Administration (FDA). Information found in the PI should be supported by substantial evidence and should be relevant to clinical practice. One section of PIs contain information on overdosage. The purpose of this study was to describe beta-blocker (BB) PI overdosage information provided within the overdosage section.
Methods: DailyMed online database was used to search FDA approved BB PIs. Data collected was obtained from the overdosage section. Only BBs with oral formulations were included. PIs were excluded if they were injectable or ophthalmic products only or had inactive national drug codes. Information collected was documented into categories of observation, decontamination, administration of atropine, glucagon or high dose insulin, vasopressor/inotrope, enhanced elimination, other, and communication with the poison center or toxicologist. Descriptive statistics were used.
Results: Of the 125 package inserts collected and analyzed, 90% (113/125) recommended atropine. Observation was not addressed in 66% (83/125) of PIs. Ipecac and emesis/forced evacuation were stated in 10% (13/125) and 29% (36/125) of PIs, respectively. Gastric lavage was stated in 55% (64/125). Glucagon was recommended in 93% (116/125) of PIs. None of the PIs (0%) recommended use of high dose insulin. Digoxin and theophylline/aminophylline were recommended in 56% (70/125) and 74% (92/125) of PIs, respectively. Hemodialysis was stated in 27% (34/125) of PIs and transvenous pacing in 60% (75/125). Only twenty (16%) stated a poison center or toxicologist be contacted.
Conclusion: The overdosage section of BB PIs may contain outdated and inconsistent with current practice management. Recommending contacting a poison center or toxicologist was infrequent. Inconsistency of overdosage information was observed among this sample. This may have significant impact in places where updated toxicologic resources are unavailable. A major limitation includes lack of all available BB PIs.

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232. Risk of peri-intubation adverse events during emergency department intubation of overdose patients: a National Emergency Airway Registry (NEAR) analysis

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Background: More than 20,000 emergency department (ED) patients undergo intubation for overdose each year. While the characteristics of patients intubated for overdose and poisoning are well described little is known about the intubation outcomes of overdose patients in the ED.
Objectives: We quantify the frequency of peri-intubation adverse events for patients intubated in the ED for overdose, and determine whether first attempt success without adverse events differs between patients intubated for overdose and patients intubated for other reasons.

Methods: We analyzed data from the National Emergency Airway Registry (NEAR), a prospective multicenter registry of ED intubations collected from an international network of 22 academic and community hospitals. We included patients 14 years and older whose first attempt was oral intubation, with data entered into NEAR between January 1, 2016 and December 31, 2018. The primary outcome was successful intubation on the first attempt. We used multivariable logistic regression to determine whether indication was independently associated with successful intubation on the first attempt after adjusting for age, gender, obesity, initial impression of difficult airway, presence of difficult airway characteristics, and use of video laryngoscopy. Secondary outcomes included successful intubation on the first attempt without adverse events, the occurrence of rescue surgical airways, and the occurrence of adverse events. Adverse events included hypoxemia, hypotension, peri-intubation cardiac arrest, bradycardia, mechanical injury to oral or airway structures, vomiting, tachydysrhythmia, esophageal intubation, laryngospasm, and pneumothorax.
Results: We analyzed 17,984 patients, including 1,983 (11%) intubated for overdose, and 16,001 (89%) intubated for other indications. Patients intubated for overdose were younger (median age 38 vs 55 years), were less frequently obese (26% vs 34%), and fewer had difficult airway characteristics (38% vs 53%). Overdose patients were more likely to have preoxygenation performed (45% vs 35%), more likely to have apenic oxygenation (39% vs 31%), and more likely to have bougie used (33% vs 17%).
First attempt success was 90.5% in patients intubated for overdose and 87.5% in patients intubated for other reasons (absolute difference 3.0%; 95% CI: -1.3 to 7.3). First attempt success without adverse events was higher in overdose patients (85.0%) compared to other patients (78.7%) (absolute difference, 6.3%; 95% CI 1.0 to 11.7%). Overdose patients experienced significantly less hypotension (1.5% vs 4.1%), and tended to have fewer adverse events overall. Multivariable model results were consistent with the unadjusted results including no difference in first pass success (adjusted odd ratio 1.02 [95% CI 0.86-1.23]). There was a higher first pass success without complication in patients intubated for overdose (adjusted odds ratio 1.23; 95% CI 1.07 to1.43).
Conclusions: First attempt success was similar between patients being intubated for overdose and other conditions. Patients intubated for overdose had lower rates of complication with first attempt success in several of our tested models. This data may allow clinicians to more accurately estimate the risks of intubation in overdose patients.

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233. Retrospective Study of dexmedetomidine for anticholinergic delirium

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Background: Anticholinergic overdose represents a common pathology to emergency departments and ICU's, with delirium a frequent manifestation. Delirium induced by anticholinergic toxicity can be challenging to manage. The risks of standard therapy with benzodiazepines include respiratory depression, seizure, and bradycardia. Adverse events and the failure to control delirium necessitates a search for a better treatment. Dexmedetomidine, a a2-adrenergic agonist sedative, shows promise for management of anticholinergic delirium with a favorable hemodynamic and respiratory profile. However, the literature lacks data on outcomes for anticholinergic overdose subjects treated with dexmedetomidine.
Methods: Adult subject charts between 2017-2020 admitted due to anticholinergic overdose at a major medical center were reviewed. Subject age, sex, and race were considered. Subjects who presented with anticholinergic overdose but did not exhibit delirium, or had known chronic psychosis, were not considered.
Subjects admitted for anticholinergic overdose who experienced delirium were assessed based on:

1. Number of days with a positive q12hr positive CAM-ICU nursing assessment
2. Length of stay (LOS)
3. Total amount of benzodiazepines received
4. Incidence of intubation
5. Incidence of bradycardia or hypotension as adverse events (AE)

The predetermined primary outcome was the absolute percent difference in adverse event rates between dexmedetomidine and benzodiazepine group (DXBZ) vs. the benzodiazepines alone group (BNZ). Demographic and baseline clinical characteristics between DXBZ and the BNZ were reported as means; standard deviations for continuous variables and frequencies; percentages for categorical variables. The Wilcox Rank Sum andChi-squared/Fisher's Exact test were used for analysis. All p-values were 2-sided and $p < 0.05$ was considered statistically significant.
Results: Seventy-eight subjects were compared (60% female, 40% male), with 16 (21%) in the group that received DXBZ and 62 (79%) in the BNZ. There was a significant difference between LOS for the DXBZ vs. the BNZ (6 days vs. 2 days, $p < 0.001$), days of positive CAM ICU assessments (1 day vs 0 days, $p = 0.004$), and rates of intubations (73% intubated vs. 38% intubated, $p = 0.021$). There were no significant differences in rates of bradycardia/hypotension or total benzodiazepine dose. After controlling for age, gender, and race, there were no statistical differences in LOS or AE between the groups, but the odds of increasing positive CAM days in the DXBZ is 5.8 times higher compared to the BNZ and the odds of intubation is 7.1 times higher compared to the BNZ. An analysis was done of subjects who received dexmedetomidine following intubation or AE and were found to have similar outcomes to subjects who received benzodiazepines alone.
Conclusion: There is no significant difference between the groups regarding AE, suggesting a similar safety profile. However, our data suggested that subjects with higher acuity and a higher burden of delirium received dexmedetomidine. In fact, only those subjects who were intubated received dexmedetomidine. We determined that even in scenarios in which subjects experienced previous relative contraindications (bradycardia or hypotension) to dexmedetomidine had similar outcomes to subjects receiving only benzodiazepines. Therefore, dexmedetomidine may be a safe therapy for subjects experiencing anticholinergic delirium due to overdose in the ICU setting.

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234. Does hepatotoxicity occur more frequently among American Indians/ Alaskan natives after acetaminophen overdose?

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Objectives: Previous research suggests that indigenous people (American Indians, Alaskan Natives, First Nations) in the United States and Canada have higher rates of acetaminophen overdose and hospitalizations than other racial/ethnic groups. Higher hospitalization rates could be due to potential disparities in healthcare access or in its delivery. To address this knowledge deficit about potential healthcare disparities, we compared the frequency of acetaminophen hepatotoxicity and n-acetylcysteine administration across 47 hospitals in the United States among non-Hispanic American Indians/Alaskan Natives to other racial/ethnic groups.
Methods: This investigation involved a query of the Toxicology Investigators Consortium (ToxIC) registry. The ToxIC registry was created in 2010 by the American College of Medical Toxicology (ACMT). Through a consortium of clinical sites, medical toxicologists voluntarily enter de-identified cases into a nationwide surveillance registry of the bedside care of patients who sustained a variety of toxicological exposures. In this investigation, we identified registry cases for which overdose of acetaminophen was identified. All acetaminophen overdose cases regardless of age between 2015-2020 were reviewed for race/ethnicity and the outcomes of hepatoxicity (defined as aspartate aminotransferase (AST) or alanine aminotransferase (ALT) > 1000), treatment with n-acetylcysteine, organ transplantation and death. Two-sample testing of binomial proportions were used to compare non-Hispanic American Indians/Alaskan Natives to other racial/ethnic groups by frequency of hepatotoxicity and n-acetylcysteine administration.
Results: A total of 6,342 acetaminophen overdose cases were identified. Of these 6,342 patients, most were 19-65 years-old (53%), while 37% were 13-18 years-old, 4% were 66 years-old and older, 3% were 7-12 years-old, 1% were 2-6 years-old, and 1% were younger than 2 years-old. The majority of patients were female (70%), while 29% were male and 1% were transgender. Among the 6,342 patients, 44% were non-Hispanic White, 13% any race Hispanic, 10% non-Hispanic Black, 2% non-Hispanic Asian, and 1% non-Hispanic American Indian/Alaskan Native. Hepatotoxicity after an acetaminophen overdose occurred more frequently among non-Hispanic American Indians/Alaskan Natives (30.8%) than non-Hispanic Whites (18.7%; $\Delta 12.1\%$, $p < 0.01$), any race Hispanics (10.9%; $\Delta 19.9\%$, $p < 0.00001$), non-Hispanic Blacks (15.0%; $\Delta 15.8\%$, $p < 0.001$, and non-Hispanic Asians (14.8%; $\Delta 16.0\%$, $p < 0.01$). However, the proportion of patients receiving n-acetylcysteine was similar among non-Hispanic American Indian/Alaskan Natives (90.8%) and non-Hispanic Whites (81.8%; $\Delta 9.0\%$, $p < 0.06$), any race Hispanics (81.5%; $\Delta 9.3\%$, $p < 0.06$), and non-Hispanic Asians (81.7%; $\Delta 9.1\%$, $p < 0.1$), yet was greater than among non-Hispanic Blacks (72.4%; $\Delta 18.4\%$, $p < 0.001$).
Conclusions: As compared to other racial/ethnic groups in the United States, non-Hispanic American Indians/Alaskan Natives more frequently have hepatotoxicity when presenting for care after an acetaminophen overdose, yet are not less likely to receive n-acetylcysteine treatment. Reduced access to healthcare or longer times from overdose to presentation to healthcare should be investigated as potential causes of disparity of disease severity, in addition to differences by metabolism and hepatologic disease. Lower use of n-acetylcysteine treatment among non-Hispanic Blacks also requires further study in regard to causes including disparities in treatment or longer presentations to healthcare after an acetaminophen overdose.

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235. Management of incidentally discovered massive bullet ingestion with associated lead toxicity

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Background: Management of ingested foreign bodies distal to the esophagus is typically conservative. Foreign bodies containing lead, however, are concerning because of the potential for the development of lead toxicity. Ingestion of lead ammunition is a notable cause of lead toxicity. This case report describes the management of an ingestion of large, numerous, presumed lead-based objects, including eighteen bullets.
Case report: A 53-year-old female presented with ingested foreign bodies that were found upon routine screening during jail intake. The patient had a history of schizoaffective disorder with psychotic features. She reported ingesting bullets and a pendant but could not provide further details. On arrival to the Emergency Department, the patient was asymptomatic. An initial abdominal X-ray showed multiple metallic opacities consistent with bullet shapes. Toxicology was consulted for foreign body ingestion with concern for lead exposure. She underwent emergent esophagogastroduodenoscopy (EGD) with removal of seventeen bullets and two bolts from the gastric body. The bullets measured approximately 50 to 60 mm in length and are consistent in size and shape with 0.223 caliber cartridges. A metallic button was also visualized in the stomach but left to pass spontaneously due to its small size. Post-procedure abdominal imaging showed removal of most of the foreign objects with one bullet remaining in right lower quadrant and the small foreign body in the epigastrium. The patient was observed in the hospital for an additional three days and given one dose of oral polyethylene glycol 3350 solution (4,000 mL). Imaging performed prior to discharge showed that the patient had passed the final bullet and the remaining small foreign body had progressed to the rectum. Her lead level was 78 ug/dL. She was discharged to police custody and a course of succimer was recommended. Repeat lead level and follow-up imaging are pending.
Discussion: In the management of lead foreign body ingestions, removal of the lead source is crucial. In reviewing previously reported cases of ingested ammunition, removal was accomplished entirely either by endoscopy or elimination through the gastrointestinal tract. This case demonstrates the successful combination of endoscopic removal of the gastric bullets and passage of the remaining bullet, aided by an osmotic agent. Urgent removal of the gastric foreign bodies by EGD was performed in this case because objects that may contain lead are known to readily dissolve in the acidic stomach. Allowing the distal bullet to pass in the stool with close surveillance and the assistance of an osmotic agent avoided an unnecessary additional procedure. The patient was also chelated with succimer after hospital discharge because of her elevated lead level.
Conclusions: This case emphasizes the importance of considering lead poisoning in patients with metallic foreign body ingestion. It also demonstrates the successful combination of urgent removal of the large gastric metallic objects and conservative management of the intestinal bullet.

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236. Initiation of an emergency department clinical toxicology consult service at an urban, academic, safety net hospital

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Background: Bedside medical toxicology consult services have been associated with improved patient care, shorter hospital length of stay (LOS), decreased cost, and increased reimbursement. Not all institutions have a medical toxicologist available for bedside consults. Some hospitals may have pharmacists that are board certified clinical toxicologists as part of the care team. Formal, bedside clinical toxicology consult services have not been well described in the literature.
Methods: We established an emergency department (ED) clinical toxicology consult service at an urban, academic, safety net hospital with over 130,000 ED visits per year. At our institution, there were initially two emergency medicine (EM) pharmacists with board certifications in clinical toxicology through the American Board of Applied Toxicology and no medical toxicologists on staff. To improve patient care by engaging the clinical toxicologists in the assessment and management of patients with toxicologic exposures, EM physicians could place an "ED Pharmacy Consult – Toxicology" order in the patient's electronic medical record during the hours in which a clinical toxicologist was working as the ED pharmacist. Poison Centers could also be contacted at time regardless of clinical toxicology consult. The clinical toxicologist assists with obtaining history and assessment, provides treatment and monitoring plan recommendations, facilitates time to antidote administration, and provides education to the medical team, patient, or caregiver. We describe the patient demographics and outcomes for the first 10 months of a formal, clinical toxicology consult service.
Results: Over the course of 10 months, there were 181 unique toxicology consults; however, less than 10 consults occurred during the 3 months our institution was affected by COVID-19 surges. The average age of the patients was 42 ± 17 years, 93% of consults were in adult patients, and 57% were male. The most common chief complaints were poisoning (15%), overdose – accidental (12%), overdose – intentional (12%), and altered mental status (8%). The substances involved were variable consisting of unknown (18%), single agents (68%), or multiple agents (14%). Of the reported single agent exposures, the five most common classes were analgesics (32%), sedative/hypnotic/antipsychotics (20%), antidepressants (18%), alcohols (77%), and stimulants and street drugs (10%). Patient disposition included admission (65%), discharge to home (23%), psychiatric admission (9%), and left against medical advice (3%). For admitted patients, the average intensive care unit and hospital LOS were 2.8 ± 1.7 and 4.3 ± 2.9 days, respectively. There were 6 deaths.
Conclusions: These results suggest that an ED pharmacist clinical toxicology consult service was frequently utilized by EM providers. The next steps for our ED clinical toxicology consult service include evaluating patient-specific outcomes and cost associated with presumed or known toxic alcohol ingestions, acetaminophen overdoses, tricyclic antidepressant overdoses, and beta-blocker/calcium channel blocker overdoses.

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237. Repetitive diphenhydramine misuse mimicking other diseases and the use of serum testing for confirmation

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Background: We present a case of a patient with suspected diphenhydramine misuse who presented to the health care setting multiples times with findings of anticholinergic toxicity. However, due to his persistent denial of ongoing diphenhydramine use, the patient was misdiagnosed with other disease processes. Serum drug level testing was eventually used to confirm the toxicologic diagnosis.
Case report: A 31 year old male with a past medical history of post-traumatic stress disorder, bipolar disorder, depression, non-insulin dependent diabetes, hepatitis C, and cyclic vomiting syndrome presented to two different healthcare facilities on eight occasions over a 4 month time period. During each visit, the patient was described to have confusion, slurred speech, mydriasis, tachycardia, hallucinations and ataxia with resolution within 24 hours. He also had seizures witnessed on 4 occasions. His daily medications reported were olanzapine, lamotrigine, and metformin. The patient denied any substance use/misuse or overdose on each occasion with the exception of occasional marijuana use. The patient had extensive laboratory testing that was unremarkable, a head CT that demonstrated no pathology, and an EEG during one of these episodes that was suggestive of underlying neuronal dysfunction with propensity to seizure but did not capture any seizure events. He was evaluated by neurology, neuropsychology, and psychiatry during his multiple hospitalizations. Diagnoses considered by these services include primary seizure disorder, psychogenic non-epileptic seizures, Ganser syndrome, and malingering.
The clinical toxicology service was consulted and the patient was diagnosed with classic anticholinergic toxicity. Diphenhydramine misuse was suspected as the cause given his clinical toxidrome and the history per the fiancé of past diphenhydramine misuse when thoroughly questioned. The patient adamantly denied diphenhydramine use when his mentation cleared and his fiancé reported that the diphenhydramine in the house was locked away and inaccessible. A serum level collected when the patient was exhibiting anticholinergic symptoms and was sent to NMS labs (lab code 1760B). Diphenhydramine was found at 3,400 ng/mL (toxic >1000 ng/mL), confirming diphenhydramine misuse.
Discussion: This patient received extensive evaluation and numerous hospitalizations because of his denial of drug use. His clinical syndrome was consistent with an anticholinergic toxidrome. Serum drug testing was utilized to confirm suspicion of diphenhydramine use despite the patient's and fiancé's denial of use and allowed for cessation of further diagnostic evaluation by other services.
Conclusions: Specific serum drug testing, due to cost and lack of accessibility, is often not utilized in patient care. However, in cases like this, specific blood level testing can be of significant benefit to confirm suspected toxicologic diagnosis and to prevent further unnecessary and costly testing.

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238. Trends in caffeine exposures reported to US poison control centers over a 10-year period from 1/1/2011 to 12/31/2020

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Background: Caffeine is a commonly used substance in the United States.
The purpose of this study is to find patterns in the reasons behind and demographics of caffeine exposure cases reported to the National Poison Data System for people aged 13 and over from 2011-2020.
Methods: A retrospective review of data reported to the NPDS was performed for the years 2011 through 2020. The data included patients who were aged 13 years and older, and who had been exposed to a single caffeine containing substance (included generic codes are caffeine, Diet Aids: phenylpropanolamine and caffeine combinations, Energy Drinks: Caffeine Containing (From Any Source Including Guarana, Kola Nut, Tea, Yerba Mate, Cocoa, etc), Energy Drinks: Caffeine Only (Without Guarana, Kola Nut, Tea, Yerba Mate, Cocoa, etc), Energy Drinks: Ethanol and Caffeine Containing (From Any Source Including Guarana, Kola Nut, Tea, Yerba Mate, Cocoa, etc), Energy Drinks: Ethanol and Caffeine Only (Without Guarana, Kola Nut, Tea, Yerba Mate, Cocoa, etc), and Energy Products: Other) due to the exposure reasons adverse reaction – Drug, intentional abuse, misuse, suspected suicide, or unknown, other- malicious and unintentional misuse, therapeutic error or unknown. This data was analyzed using Microsoft Excel software for descriptive statistics to characterize trends throughout the 10-year study.
Results: A total of 15,218 exposures to caffeine were reported during the 10-year study period. The mean count of reported cases is 1521.8 (SD 99.17) per year. 2015 has the highest case count, at 1669 cases, while 2020 had the lowest case count at 1337 cases.
Gender results show 53.5% (8012) were male and 47.25% (7178) were female. Over the 10-year period the patients had a mean age of 26 (SD 12.17), median age of 22 (IQR =12) and mode age of 18.
Out of total exposure reasons 34% (5242) were intentional misuse.
Of the 15,218 cases reviewed, 3.77% (573) developed no clinical effects, 27.65% (4203) had minor, 22.08% (3660) had moderate, 1.01% (154) had major, and 0.06% (9) of cases had fatal outcomes. 4725 (31.05%) of cases were coded not followed, minimal clinical effects possible or no more than minor effect possible.
Of the caffeine exposures, 23% (3523) individuals developed more severe effects coded as moderate, major and death. Of these three outcomes, >95% were moderate effects.
Conclusion: Overall, rate of caffeine exposure remained consistent over the study period, and most outcomes were not severe. One third of exposures were due to intentional misuse, with 36.68% of exposed children (13-17) being exposed due to intentional misuse.

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239. Characterization of intravenous sodium bicarbonate use for prolonged QRS intervals in poisoned patients reported to a regional poison center

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Background: QRS prolongation is a known complication of toxic exposures from agents that have sodium channel blockade properties. It is common practice to treat sodium channel blocker-induced QRS prolongation with intravenous sodium bicarbonate. However, many other drug exposures have shown the potential to increase QRS interval with either no or unknown mechanistic effect on sodium channels. It is not uncommon for providers to attempt a trial administration of sodium bicarbonate to treat the prolonged QRS. The goal of this study is to further examine agents that have caused QRS prolongation reported to our regional poison center (RPC) and the effectiveness of sodium bicarbonate for narrowing these reported QRS intervals.
Methods: This was an IRB-approved retrospective chart review of human exposure cases reported to a single RPC from calendar years 2017 through 2020 with documented prolonged QRS interval treated with intravenous sodium bicarbonate. Cases were identified using the National Poison Data System code for "Prolonged QRS." Data collected from each case included: exposure agent, peak initial QRS interval, sodium bicarbonate administration, and repeat QRS after sodium bicarbonate administration. QRS prolongation was defined as a QRS interval >110msec or 20msec longer than the patient's baseline value as determined by serial monitoring. Cases that described multi-agent ingestions, no sodium bicarbonate administered, or sodium bicarbonate administered for other reasons were excluded.
Results: Within a 4-year period, 1,149 exposure cases were identified to have a prolonged QRS interval, 552 of which were identified as single-agent ingestions. However, only 96 cases met all inclusion criteria, including a documented sodium bicarbonate administration after an initial wide QRS with a documented repeat ECG post-bicarbonate. In 28 (29%) of these cases, narrowing of the QRS interval was documented after sodium bicarbonate administration. Particularly noteworthy is the 73% response rate to sodium bicarbonate in diphenhydramine cases, while other agents, including amitriptyline, nortriptyline, quetiapine, and bupropion, responded less frequently. The possibility of improved response at an increased dose of bicarbonate in these agents is uncertain.
Conclusions: In this retrospective review, QRS narrowing was uncommon among xenobiotics not known to have sodium channel blockade properties. The most common exposures warranting intravenous sodium bicarbonate administration included diphenhydramine and tricyclic antidepressants. Diphenhydramine exposures demonstrated the most frequent and profound QRS narrowing response after sodium bicarbonate administration. The majority of antidepressant cases did not demonstrate narrowing of QRS to less than 100 msec after initiation of sodium bicarbonate, which could be explained by inadequate bicarbonate dosing, prolonged toxin absorption, or massive overdose. The majority of non-sodium channel blocker xenobiotics did not demonstrate clinically important narrowing of QRS interval on initiation of sodium bicarbonate. This data suggests sodium bicarbonate administration and optimal dosing requires further analysis, particularly in non-sodium channel blocker exposures.

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240. Comparing the prognostic performance between tangent and threshold methods of QT measurement for drug-induced torsade de pointes

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Background: Threshold (Thr) and tangent (Tan) methods are commonly used for QT measurement. Each has pros and cons. Nothing has known if those pros and cons would affect any clinical outcomes.
Objective: To compare prognostic performance between Thr and Tan methods of QT measurement for drug-induced torsade de Pointes (TdP).
Methods: This was a prognostic study using a case-control design. Case-group included patients who had drug-induced TdP from a systematic search from Medline since the establishment to January 31st, 2021. Control-group enrolled patients who overdosed on QT-prolonging drugs, without TdP. They were from the toxicology logbook, Emergency Department, Vajira Hospital, from August 1st, 2013 to November 18th, 2018. Both groups were >15 years old without a diagnosis of other dysrhythmias, and congenital LQTS or other cardiomyopathies. Interval measurements were done by 4 measurers using both threshold (Thr) and tangent (Tan) methods, interrater reliability using intraclass correlation coefficient from 240 ECG leads were 0.95 and 0.95, for QT (Thr) and QT (Tan), respectively.
Results: 180 and 180 patients were equally included in the case and control groups. QT intervals were longer significantly (p-value <0.001) when measured by Thr method . AUROCs from the Thr were also greater than ones from the Tan, regardless of QT-correction formulas. However, differences in AUROCs between the two were not significant. Using Youden's index for selecting a cut point, the best cut points from the Thr method were always at a longer QT interval. The best cut points (of any QT-correction formulas) from the Thr provided slightly better accuracies (1-2%) than the ones from the Tan method.
Conclusion: Our study suggests that both methods could be used without affecting the main clinical outcome significantly. When clinicians select a cut point to stratify the risk of TdP, they should be cautious that the cut point they use was originally from what type of QT measurement and QT-correction formula to maintain high prediction performance as was the original.

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241. Fidget spinner ingestions and other injuries treated at emergency departments

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Background: Fidget spinners became trending toys in 2017. A fidget spinner is a metal or plastic toy that consists of a ball bearing center piece surrounded by a multi-lobed outer piece that spins on its axis with some containing light-emitting diodes powered by disc batteries. The objective of this study was to describe fidget spinner injuries managed at United States (US) emergency departments (EDs).
Methods: The data source for this study was the National Electronic Injury Surveillance System (NEISS), a database of consumer product-related injuries collected from the EDs of approximately 100 US hospitals. Fidget spinner injuries reported during 2017-2019 (none were identified prior to 2017) were defined as those records where the Narrative Field mentioned "fidget spinner" or various misspellings of the words. The cases were divided into those involving ingestion/aspiration of a part of the fidget spinner and all other injuries. The distribution of the two types of fidget spinner injuries was determined for various factors related to patient demographics, injury circumstances, diagnosis, and disposition and comparisons were made between the two types of injury.
Results: Of 74 total reported fidget spinner injuries, 42 (56.8%) involved ingestion (n = 40) or aspiration (n = 2) of a part of the device. Twenty-seven (64.3%) of the ingestions/aspirations occurred during 2017; 10 (23.8%) during 2018; and 5 (11.9%) during 2019. Six (14.3%) of the ingestions/aspirations involved a disc battery. The patient age distribution was 25 (59.5%) 0-5 years; 16 (38.1%) 6-12 years; and 1 (2.4%) 13-19 years. Twenty-five (59.5%) of the patients were male and 17 (40.5%) female. The location where the ingestion/aspiration occurred was 17 (40.5%) home; 1 (2.4%) school; 1 (2.4%) other public property; and 23 (54.8%) not stated. Thirty-eight (90.5%) were treated or examined and released and 4 (9.5%) were treated and admitted for hospitalization. Of the 32 (43.2%) with other injuries, 25 (78.1%) occurred during 2017 and 7 (21.9%) during 2018. Eight patients (25.0%) were 0-5 years, 15 (46.9%) 6-12 years; 3 (9.4%) 13-19 years; and 6 (18.8%) 20 years or older. Twenty-one (65.6%) patients were male and 11 (34.4%) female. The location where the injury occurred was 20 (62.5%) at home, 1 (3.1%) at school, 1 (3.1%) on a street or highway, and 10 (31.3%) not stated. The disposition was 30 (93.8%) treated or examined and released, 1 (3.1%) treated and admitted for hospitalization, and 1 (3.1%) left without being seen/against medical advice. The type of injury was 9 (28.1%) laceration, 6 (18.8%) attached foreign body, 3 (9.4%) contusion, 3 (9.4%) dental injury, 2 (6.3%) thermal burn, 2 (6.3%) traumatic iritis, 1 (3.1%) abrasion, 1 (3.1%) headache, 1 (3.1%) hematoma, 1 (3.1%) otic foreign body, 1 (3.1%) strain, and 3 (9.4%) unknown.
Conclusion: The majority of fidget spinner injuries occurred during 2017 then declined the following two years. While the majority of ingestions/aspirations involved male patients age 0-5 years, the highest proportion of other injury patients were males age 6-12 years. Most patients were treated or examined and released from the ED. No deaths were reported.

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242. Hand sanitizer exposures treated at emergency departments

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Background: Hand sanitizers are antimicrobial agents supplied in liquid, gel, or foam formulations. The most common types of hand sanitizers used in the United States (US) are alcohol-based, containing 60% or more ethanol or isopropanol. Ingestion of hand sanitizers can have serious adverse effects. Acute ethanol intoxication can result in such effects as tachycardia, cardiac dysrhythmias, central nervous system depression, ataxia, tremors,

seizures, nausea, vomiting, diarrhea, hepatic injury, hypothermia, and respiratory depression. The objective of this study was to describe hand sanitizer exposures managed at 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. In order to identify hand sanitizer exposures reported during 2000-2019, all records with the letter combinations "han" and "san" in the record narrative were reviewed, and those that appeared to be hand sanitizer exposures were included in the study. The distribution of estimated hand sanitizer exposures was determined for various factors related to patient demographics, exposure circumstances, diagnosis, and disposition.
Results: A total of 211 hand sanitizer exposures were identified, resulting in a national estimate of 7,119 exposures. By four-year period, there were 160 (2.2%) exposures during 2000-2003, 778 (10.9%) during 2004-2007, 1,693 (23.8%) during 2008-2011, 2,726 (38.3%) during 2012-2015, and 1,761 (24.7%) during 2016-2019. The patient age distribution was 5,518 (77.5%) 0-5 years, 273 (3.8%) 6-12 years, 398 (5.6%) 13-19 years, and 929 (13.1%) 20 years or older; 3,938 (55.3%) of the patients were male, and 3,180 (44.7%) female. The patient's race was 3,847 (54.0%) white, 938 (13.2%) black/African American, 471 (6.6%) other, and 1,863 (26.2%) not stated. The route of the exposure was 5,722 (80.4%) ingestion, 435 (6.1%) ocular, 955 (13.4%) dermal, and 6 (0.1%) unknown. The reported location where the exposure occurred was 4,357 (61.2%) home, 452 (6.4%) other public property, 146 (2.1%) school, 6 (0.1%) place of recreation or sports, and 2,157 (30.3%) not recorded. The diagnoses were 5,712 (80.2%) poisoning, 493 (6.9%) dermatitis/conjunctivitis, 419 (5.9%) thermal burn (from the hand sanitizer catching on fire), 135 (1.9%) chemical burn, 11 (0.2%) internal organ injury, 5 (0.1%) ingested foreign object, and 343 (4.8%) other/not stated. The patient disposition was 6,398 (89.9%) treated or examined and released, 223 (3.1%) treated and admitted for hospitalization, 207 (2.9%) held for observation, 215 (3.0%) left without being seen/against medical advice, and 76 (1.1%) not recorded.
Conclusion: Hand sanitizer exposures most often involved patients who were children age 0-5 years and male. The majority of the exposures occurred by ingestion followed by dermal and ocular routes. Most patients were treated or evaluated and released from the ED,

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243. Poison center contacts documented in the National Electronic Injury Surveillance System

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Background: Studies have shown that poison centers reduce hospital stay length when consulted by healthcare facilities in cases of poisonings. However, poison centers are not contacted in the majority of poisonings seen at healthcare facilities. The objective of this study was to characterize poison center contacts documented in the National Electronic Injury Surveillance System (NEISS).
Methods: Data were obtained from NEISS, a database of injuries due to consumer products among patients of all ages and poisonings and chemical burns to children less than 5 years of age collected from the emergency departments of approximately 100 United States hospitals. A national estimate was calculated from the database records based on the sample weight assigned to each case. All NEISS records during 2000-2019 with the following letter combinations in their narrative were identified: "pc," "pois" and "con," "pois" and "cent," "pois" and "cnt," and "pois" and "ctr." The narratives of the resulting subset of records were reviewed to identify those where it appeared to document that a poison center had been contacted.
Results: A total of 2,337 records with documented poison center contact were identified, resulting in a national estimate of 79,918 poison center contacts. This estimate represented 0.03% of the 273,309,060 estimated total records. The diagnosis was poisoning in 70,547 (88.3%) of the poison center contacts, representing 2.5% of the 2,836,649 total poisoning records. The next most common diagnoses were 2,360 (3.0%) ingested foreign object, 2,117 (2.6%) chemical burn, 1,079 (1.3) dermatitis or conjunctivitis, and 854 (1.1%) anoxia. By four-year period, there were 19,093 (23.9%) poison center contacts during 2000-2003, 10,754 (13.5%) during 2004-2007, 11,692 (14.6%) during 2008-2011, 17,834 (22.3%) during 2012-2015, and 20,545 (25.7%) during 2016-2019. The age distribution was 71,158 (89.0%) 0-5 years, 2,438 (3.1%) 6-12 years, 1,237 (1.5%) 13-19 years, and 5,086 (6.4%) 20 years or older; 43,990 (55.0%) of the patients were male and 35,928 (45.0%) were female. The patient race was 43,940 (55.0%) white, 8,093 (10.1%) black/African American, 3,537 (4.4%) other, and 24,349 (30.5%) not stated. The injury location was 60,278 (75.4%) home, 899 (1.1%) other public property, 516 (0.6%) school, 154 (0.2%) street or highway, 69 (0.1%) place of recreation or sports, 22 (0.0%) farm or ranch, and 17,981 (22.5%) not recorded. The patient disposition was 70,312 (88.0%) treated or examined and released, 1,737 (2.2%) treated and transferred to another healthcare facility, 2,462 (3.1%) treated and admitted for hospitalization, 2,767 (3.5%) held for observation, 2,552 (3.2%) left without being seen/against medical advice, and 88 (0.1%) not recorded. The most common products involved in the injury were 44,450 (55.6%) medications, 4,016 (5.0%) general purpose household cleaners, 3,918 (4.9%) bottles or jars (not specified), 3,436 (4.3%) cosmetics, 3,013 (3.8%) bleaches (noncosmetic), and 2,257 (2.8%) laundry soaps or detergents.
Conclusion: Poison centers were documented as contacted in only 0.03% of total injuries and 2.5% of total poisonings. However, the NEISS database does not appear to require that poison center contact be documented in the narrative, so these percentages are likely underestimates.

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244. EVALI during the COVID-19 pandemic: a needle in the ground glass

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Background: COVID-19 pneumonitis has become a predominant respiratory diagnosis in the Emergency Department (ED). Consequently, other disease processes could be overlooked-especially in younger patients- including E-cigarette or Vaping Product Use-Associated Lung Injury (EVALI). A case of a patient with EVALI mistaken for COVID-19 is presented.
Case report: A 16-year-old boy with past medical history of asthma presented to the ED with dyspnea and cough of abrupt onset 24 hours prior to ED visit. He had been using his home albuterol without improvement. There were no known sick

contacts, but patient was employed at a chain restaurant. Notable vital signs included: heart rate 116 beats per minute, respiratory rate 32, room air pulse oxygenation 90% (with a change to 99% on high flow nasal canula 40L/50%), temperature 100.2°F. Chest x-ray demonstrated bilateral pulmonary infiltrates concerning for multifocal pneumonia and possible evolving acute respiratory distress syndrome (ARDS). Chest computerized tomography (CT) scan revealed: "Diffuse bilateral ground glass opacities. Considerations include viral and atypical pneumonia, including COVID-19 pneumonitis." Notable blood work included: white blood cell count 19.4 thou/cm (reference 3.8-10.4 thou/cm) and troponin I 0.27 ng/mL (<0.03 ng/ml). Both urine drug screen of abuse and serum liquid chromatography–mass spectrometry (LC-MS) detected tetrahydrocannabinol (THC). Patient was admitted to the pediatric intensive care unit with presumptive diagnosis of COVID-19 infection. On hospital day (HD) 1 patient was transitioned to BiPAP for worsening tachypnea. Blood culture, urine legionella, and respiratory viral panel (including COVID-19) returned negative. Respiratory viral panel was repeated and again returned negative. Upon further inquiry, patient reported vaping on the day his symptoms began and smoking cannabis regularly. Treatment remained supportive with supplemental oxygen and intermittent albuterol/ipratropium nebulization. Patient was weaned from oxygen by HD 5 and discharged in stable condition on HD 6.

Discussion: EVALI is defined as recent vaping use with development of pulmonary infiltrates on chest imaging in the absence of another identifiable cause. Although EVALI is associated with vape liquid containing THC and vitamin E acetate, no single agent has been definitively implicated. Typically, EVALI is associated with counterfeit or user filled cartridges. However, this patient reported a single use vape pen purchased from a convenience store. EVALI treatment is primarily supportive with supplemental oxygen, bronchodilators, steroids, and vaping cessation.

Conclusion: Despite COVID-19, it is imperative to obtain a detailed social history and to maintain a broad differential in patients with acute respiratory complaints.

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245. Stones, moans, groans and silicone: severe hypercalcemia following liquid silicone gluteal augmentation

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Background: Cosmetic augmentation of the buttocks is a relatively common procedure and may be performed utilizing several techniques. A frequent method involves injecting liquid silicone as a permanent filler directly into the buttocks. Silicone is typically considered a benign, inert substance, however localized integumentary reactions are commonly reported adverse effects. Life-threatening silicone-induced granulomatous reactions are rare. We report a case of severe, recurrent hypercalcemia secondary to silicone-induced granulomatous disease in a female with a remote history of gluteal silicone injections.

Case report: A 39-year-old female presented to the hospital with weight loss, anorexia, weakness, nausea, and vomiting. She stated symptoms have been intermittent over the past several years. Physical examination was remarkable for cachectic appearance with a body mass index of 13 kg/m^2 as well as numerous large palpable nodules and scarring to buttocks and upper legs. She reported receiving silicone injections for buttocks augmentation twenty years earlier in the Dominican Republic. Patient reported her silicone injections had caused her similar symptoms 10 years ago and she underwent attempted surgical excision of the associated granulomas at that time. Review of symptoms demonstrated progressive abdominal pain, loss of appetite, and chronic buttock and lower extremity pain. Family reported non-specific personality changes in the patient. Labs on admission were notable for hemoglobin 8.4 g/dl, creatinine 2.1 mg/dl, calcium 17.2 mg/dl (8.5-10.1), and ionized calcium 1.89 mmol/L. The corrected calcium was 18.7 mg/dL, accounting for an albumin of 2.3 g/dL. An MRI of the pelvis was obtained and showed diffuse, extensive edema and multiple foreign body granulomas within the subcutaneous tissues of the pelvic wall/ gluteal region and proximal thighs. It was determined the patient was experiencing hypercalcemia from her silicone granulomatous disease following an extensive, multi-disciplinary team evaluation that ruled out other potential etiologies. Hypercalcemia was initially treated with intravenous fluids, calcitonin, and corticosteroids. Patient elected to have surgical excision of the granulomas performed and pathology confirmed siliconomas. Upon discharge the patient's calcium was 10.8 mg/dL. Patient has had multiple subsequent admissions for continued surgical excisions, reconstruction with skin flaps, and wound infections.

Discussion: Silicone is utilized in multiple cosmetic enhancement procedures. Silicone can be introduced directly in liquid form (as in our case) or upon rupture of a silicone-filled implant. Although silicone is typically considered a benign and an inert substance, it may induce a localized granulomatous reaction. The timeframe in which this reaction occurs may be years after the initial operation. Even when silicone-granulomatous reactions occur, they are rarely associated with hypercalcemia. The mechanism of silicone-induced hypercalcemia is unknown and currently there is no consensus regarding treatment. Standard hypercalcemia treatment including intravenous hydration, calcitonin, bisphosphonates, and corticosteroids has been utilized for silicone granulomatous induced hypercalcemia. Surgical excision of the siliconomas has also been described.

Conclusion: Severe hypercalcemia secondary to silicone granulomas is a rare clinical entity and underreported in the toxicology literature. It is an important consideration when evaluating patients with cosmetic augmentations.

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246. Changes in cannabis exposures following recreational legalization and the COVID-19 pandemic reported to a poison control system

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Background: Since 2012, eighteen states and the District of Columbia have legalized recreational cannabis. Past research suggests this policy change is associated with increased cannabis exposures, however this has not yet been studied in this state, despite its status as the world's largest legal cannabis market.

Methods: We analyzed the trends in cannabis exposures reported to a single state-wide poison control system from 2010 to 2020 using interrupted time series analysis. Cases that contained a marijuana related product code over the study period were identified for review. Cases were included if the review of

case notes indicated they involved a human exposure to a marijuana containing product. Exclusion criteria were information calls, animal exposure, out of state exposures. The study period included legalization of recreational cannabis use, the establishment of a recreational retail sales market, and the institution of a statewide shelter in place order during the COVID-19 pandemic; the dates of these policy changes were used to identify comparison groups. Data collected: type of marijuana product involved, single vs multi-substance exposure, route of exposure, age and gender. This study was determined to be exempt by the institutional review board.

Results: A total of 10,757 human exposure cases to marijuana products were included after 1,351 (11%) were excluded. Age distribution included: 20% age <6 years; 6% between 6 and 12 years; 24% between 13 and 19 years; 50% were adults >19 years. Ingestion was the route of exposure is 79% of cases. Cannabis exposures significantly increased following recreational legalization in 2016 ($p < 0.01$) and initiation of retail sales in 2018 ($p < 0.05$). There was no significant change in cannabis exposures following the first shelter-in-place order of the COVID-19 pandemic ($p = 0.43$). Significant increases in exposure to specific marijuana product types over the study period included: gummies, candies, chocolate, dabs, edibles, hemp products, joints, blunts, oils, vape products, and other edible marijuana products. Cases involving cookies, brownies, other edible baked goods, hash, plant products, and synthetic marijuana products had no significant increase. There was no significant change in marijuana related exposures observed after the implementation of state-mandated shelter-in-place orders.

Discussion: We found an increase in cannabis exposures following recreational legalization and establishment of retail sales. Our findings suggest that legalization is linked to increased exposures, particularly for edibles and among children under the age of thirteen.

Conclusions: Changes in cannabis policies have been followed by significant increases in cannabis exposures, particularly for products such as gummies and candy edibles which appeal to children. Clinicians should be aware of these risks and communicate them to patients, and policymakers should consider stronger regulations on packaging to reduce these exposures.

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247. Outbound texting – the new normal for follow-ups?

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Background: Prior to 2019, poison centers (PCs) observed a downward trend for human exposure case volume. There has been a 10% reduction in human exposure case activity nationwide from 2020 (n = 2,105,216) to 2011 (n = 2,340,602). Many reasons were postulated, such as safer packaging, increased poison prevention, education campaigns, resulting in less exposure to substances. But the biggest contributing factor likely resides in the availability and accessibility to technology. Resources can be readily available by internet and/or social media any time of the day. Younger generations are typically more computer/device-savvy and may prefer to look up information online versus make calls for advice. Similarly, when poison centers make follow-up calls, the yield of reaching someone by phone is not high. They might not have time to talk or do not recognize the caller identification. We postulated that trying to obtain follow-up by text message (SMS) might be more successful and preferable to a caller over a telephone call while at the same time reducing time spent by staff on follow-ups. Our poison center has offered SMS and chatting options (omnichannel capabilities) for individuals who browse our website since 2017. Based on the hope of improving follow-up efficiency and meeting caller preferences, our PC decided to pursue exploring outbound message capabilities; specifically, *following up with a person who initially called our poison center* for advice, by SMS. This led to the PC implementation of outbound SMS capabilities.

Methods: The project initiation was in June 2020. We received a demonstration by our omnichannel vendor and created business requirements by September 2020. A committee involving IT members (including a lead project manager), PC subject matter experts and interested stakeholders was convened. Regular meetings were conducted to prepare the master scope of work. Integration into our case management software (CMS) was mandatory and conducted by the software vendor. A phased approach was planned; Phase I involves sending a caller their case number by SMS. Phase II: sending customized messages; Phase 3: satisfaction surveys. To initiate the process, our CMS consumes an Application Programming Interface (API) provided by the omnichannel platform. When a caller opts-in (by verbal consent), an SMS is sent to the caller containing their case number. The outbound message is populated using a macro script allowing patient-specific details (case number). Callers receive their SMS instantly and the omnichannel software's API will return an indication of successful or failed message transmission. This status note would be added to the case notes within the CMS. Regression and user acceptance testing was conducted by April, 2021 and go-live launched on April 22, 2021.

Discussion: Poison center specialists in poison information (SPIs) were overwhelmingly positive about this newly implemented technology. Analytics are in progress to determine how many outbound SMS messages have been sent. However, based on feedback from SPIs, it is currently widely utilized for all non-healthcare facility types of calls. SPIs have overwhelmingly commented that it has saved them time from manually searching for a case.

Conclusions: We look forward to future expansion (Phase 2, 3, and more) of this modern tool to improve workload efficiency and improve patient satisfaction.

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248. Move over Delta-9! A case of pediatric exposure to Delta-8-THC

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Background: Delta-8-THC (Δ8THC, tetrahydrocannabinol) is a cannabinoid extracted from hemp and an isomer of the major psychoactive component in marijuana, Delta-9-THC (Δ9THC). Delta-8-THC is purportedly less potent than Δ9THC and advertised to possess little to no psychoactive properties. Δ8THC is likely more popular in states with restrictive or no legal access to marijuana, because like hemp products that contain <0.3% Δ9THC (like cannabidiol), they remain legal. Sale of Δ8THC products is an emerging opportunity for the marijuana industry to take advantage of legal loopholes in markets or consumer streams that have banned marijuana derivatives but not hemp and its byproducts. We present a case of pediatric Δ8THC exposure in a marijuana-friendly state.

Case report: Emergency Medical Service (EMS) providers consulted our regional poison center (RPC) from the home of a generally healthy, 2 year old male with an unknown, but potentially large ingestion (estimated between 2 to 100 gummies) of a product labeled "Delta-8 Hybrid Gummy Mix Vegan Non GMO, Dietary Supplements". EMS reported that the product label print

was small and difficult to read, the listed website was non-functioning during attempts to verify the product ingredients, and did not list the THC content or potency. Parents reported the child was drowsy but the timing coincided with normal naptime. Based on symptoms not being consistent with a cannabidiol-like exposure and more consistent with Δ9THC, RPC staff referred the child into the Emergency Department for observation.
The treating physician reiterated the label was difficult to read and stated active ingredients of Δ8THC as being "25-50 mg or 2.5 - 5 mg per 5 piece serving". The child presented lethargic with blood pressure 85/50, heart rate 119, respiratory rate 24, afebrile, and normal room air oxygen saturations. Acetaminophen and salicylate concentrations were negative. Rapid, qualitative immunoassay detection for THC cannabinoids in his urine was positive (cutoff concentration for 11-nor-9-carboxy-Δ^9-THC =50 ng/ml). The child was monitored for 7 hours, given IV fluids and discharged with resolution of symptoms. Initially, parents reported this was a non-THC containing "dietary supplement" ordered online, though later in the course of care reported a family member brought it home from his worksite, a national shipping service, where it was previously confiscated.
Discussion: This is the first exposure involving Δ8THC reported to our RPC and the child exhibited symptoms consistent with Δ9THC. Duration of symptoms also mimicked minor pediatric ingestion of THC. The State Health Department was notified of this case and attempts to test the actual product were unsuccessful, a chief limitation. Another limitation was lack of confirmatory testing of the patient's urine.
Conclusions: RPCs, especially in states with strict marijuana laws, should be aware of the presence of Δ8THC cannabinoid in seemingly legal hemp or products touting to have similar properties as cannabidiol. RPC staff should employ a conservative approach and manage exposures to Δ8THC with the assumption that Δ9THC-like symptoms may manifest. Furthermore, Δ8THC products may be marketed with misleading labels lacking critical ingredient information, further strengthening the need for conservative management of symptomatic exposures.

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249. The dreaded unmarked bottle: a case of fatal pediatric ingestion

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Background: Poison Centers can provide life-saving advice when a known substance is ingested. When mystery substances are ingested, this can be problematic when the puzzle pieces don't fit. We present a tragic case of a child who, mistaking it for juice, ingested a substance from an unmarked bottle which ultimately resulted in death.
Case report: An 8-year-old healthy male was taken to the emergency department (ED) with chief complaint of nausea, vomiting x5 episodes, and throat irritation. The regional poison center (RPC) was told that 2 hours ago, he ingested approximately 1 mouthful of a liquid from an unmarked bottle which he thought was juice. The product was borrowed from a friend so exact identification was not immediately known other than it was a "weed killer". In the ED he was tachycardic and hypertensive but otherwise stable. Fluids and antiemetics were recommended, with emphasis to identify the product. 3 hours post-ingestion, family reported the herbicide as containing clopyralid, a pyridine herbicide. The child's status was unchanged, and RPC advised symptomatic and supportive care based on the low toxicity profile of clopyralid. At follow-up, RPC informed that the child was medically cleared and discharged home. RPC contacted by ED 15 hours post ingestion; child had returned due to persistent vomiting (described as black), severe diarrhea, and fever (104°F). Upon presentation he appeared altered with abnormal head movements, unsteady gait, and tachycardia (HR 179). Family confirmed the herbicide as clopyralid-containing. RPC advised team to broaden the work-up and consider other etiologies as symptoms were not consistent with clopyralid ingestion. He continued to decompensate in the ED and at the 20-hour post ingestion mark, the patient's brother, who was at bedside, provided new history and identification of herbicide labeled "Tribune Herbicide" containing 37 % diquat dibromide. Abnormal vital signs were HR 173, RR 34 and he was pallorous and ataxic, with persistent diarrhea. He was admitted to the pediatric intensive care unit and intubated and sedated for airway protection. Complications included rhabdomyolysis, acidosis, hematemesis, hyperthermia, anuria with renal failure, hepatic dysfunction, and severe ventilation/oxygenation impairment. Imaging showed bilateral lung infiltrates and thickening of the esophageal wall. Therapies given: cooling measures, benzodiazepines, morphine, acetaminophen, ceftriaxone, prochlorperazine, H_2-blockers, IV fluids, N-acetylcysteine, vasopressors, sodium bicarbonate, nitric acid for ARDS, stress-dose steroids, and cyclophosphamide. Continuous renal replacement was initiated. ECMO was recommended. Despite aggressive resuscitative efforts, the patient died 42 hours after diquat ingestion.
Discussion: Diquat is functionally related to paraquat and a potent redox cycler and readily converts to a free radical which, in reaction with molecular oxygen, generates superoxide anions and subsequently other redox products. These products can initiate lipid peroxidation (destruction) of biological membranes and ultimately cell death. Death occurs from multi-organ system failure, which occurred in this patient. The 20-hour delay in product identification complicated the hospital management.
Conclusion: We report a tragic case of diquat ingestion in a pediatric patient resulting in death. This case re-emphasizes the importance of keeping chemicals in their original bottles.

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250. Determining referral sources to the poison control helpline among callers to a regional poison control center

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Background: Poison center education staff is tasked with ensuring the public knows how and when to access a poison control center for care. The memorability of the poison control phone number (1-800-222-1222) and its ease of access have not been widely studied. To improve outreach strategies and the accessibility of the poison control phone number, a Regional Poison Control Center (RPCC) sought to identify how callers obtained the number to reach the center.
Methods: Callers to the RPCC concerned with low-acuity exposures were queried during a two-month study period about how they received the phone number to contact poison control. Cases were included if the call came from a county served by the RPCC, the caller was a member of the general public (non-healthcare provider), and the case was a human exposure requiring no follow up (n = 1,204). Blind transfers were excluded. Specialists in Poison Information (SPIs) answering the phones asked callers meeting inclusion criteria how they received the phone number to reach poison control. The center's case database was customized to provide referral options SPIs could select

and code into the case. Cases were reviewed to ensure inclusion criteria was met.
Results: Of the 1,204 cases, 593 (49%) reported getting the poison control number from the Internet, 170 (14%) received the number from a doctor's office, and 118 (9%) from product packaging. In 13% of cases, people reported already having the number to poison control, thus not requiring a referral. Less-cited referral sources included Emergency Department/nurse triage line (4%), family member (3%), or pharmacy (2%). Of those using the Internet to reach the RPCC, 66% were calling about a child under age six. In 25% of Internet referrals, SPIs recorded "Google™" as the Internet referral site. Of those calling a doctor's office first, 77% were calling about a child under six, and of those referred by product packaging, 58% were calling about a child under six.
Conclusions: Nearly half of callers in this study accessed the RPCC through the Internet. It is unclear whether the majority of these callers specifically went to the Internet to find the poison control number or to find online advice related to exposures. However, poison centers can consider an increased online presence to enhance public visibility. Since over three-fourths of callers accessing the RPCC via a doctor's office were seeking help for children under age six, centers can consider furthering partnerships with pediatric practices. The study design was limited to callers concerned with low-acuity human exposures. Referral results may differ when sampling callers from the general public with human exposures of all severity levels. Poison centers can also weigh the importance of direct access vs. referral access and which points of access to amplify. Direct access may be improved by increasing the public's overall familiarity with poison control. Because many callers used the Internet to acquire poisoning advice or the RPCC phone number, these findings support heightening poison center visibility online.

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251. Assessing the strengths and needs of the Navajo nation: understanding the factors that influence poison center awareness, poison-related knowledge and poison center utilization

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Background: In New Mexico from 2013-2017, 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). Assessing the needs and strengths of tribal communities is necessary to develop relevant and effective poison prevention materials for native populations.
Methods: In 2018, a survey consisting of 16 multiple choice and short answer questions was used to gather primary data from Community Health Representatives of the Navajo Nation. The questions were designed to measure general poison center awareness, poison-related knowledge and poison center utilization of the respondents and their respective communities.
Results: A total of 82 surveys were collected. When asked who they would call if they need help with a poisoning, the respondents were more likely to call emergency medical services (52.28%) than their poison center (49.25%). When asked why they did not select the poison center for help with a poisoning, "living in remote areas with no cellular service and some people don't have landlines" were recurring themes. However, 52% of the respondents reported that their community members used Lifeline phones ("Obama Phones") as their primary telephone.
Twenty percent of the respondents reported that they believed the poison center was open 24 hours a day, year around. Only 9% of the respondents reported that they believed there were interpretation services available, and 8% believed that they can trust the poison center.
The top three reported poison-related issues within their communities were contaminated water (42%), prescription and over the counter drug abuse (37%), and medication errors (34%). The top platforms for receiving poison prevention education were printed materials (25%) and radio public service announcements (25%).
Conclusions: Lack of the following factors appear to be driving decreased poison center utilization: cellular reception, trust in poison center services, poison center awareness, knowledge of the poison hotline and illiteracy among some sectors. Therefore, outreach materials need to be literacy and age appropriate, culturally sensitive, and pertain to contaminated water, prescription drug abuse, and medication errors.
Gaining and maintaining the trust of tribal communities is crucial to gaining access to these populations. Every effort should be made to establish relationships with respected and trusted individuals within the target communities. Also, recruiting a specialist who speaks Navajo/Dine fluently may go a long way in increasing the trust of native populations and in improving communication issues.
Lifeline phones are not only popular within the Navajo Nation, but they also offer unlimited texting. Therefore, the cost and logistics of implementing a program that allows tribal communities to communicate with poison center specialists via texting should be investigated.

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252. Do rural and urban populations report exposures to the same substances?

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Background: In this state, nearly 1/3 of the 6.1 million residents live in 110 sparsely-populated rural counties, while 2/3 reside in densely populated cities and 5 urban counties. Location affects many population factors such as education level, employment status, and income. The rural-urban dichotomy also leads to many differences in health concerns as well as access to healthcare. Most poison centers service the entire state population, and must address the exposures of both geographic groups. This research seeks to determine the similarities and differences in the substances involved in poison exposures between urban and rural dwellers over a 5-year period.
Methods: The 115 counties in the state were categorized as rural or urban based on the classification provided by the state census data center. Archived Toxicall® single and multi-exposure records for all ages were searched by substance generic code, by category, for a 5-year period, January 2015-December 2020. The 67 substance generic codes condense the myriad agents named in the exposures into broad categories of related agents. Exposure cases were separated into urban and rural subgroups based on the county recorded for the initial exposure. The 67 substance

categories were then ranked numerically from most common (1) to least common (67) in each subgroup based on their frequency in the datasets. The rank numbers assigned to each substance category in both the urban and rural subgroups were compared, and the numerical difference between them determined the rank difference for each substance category.
Results: In the urban group there were 107,799 exposure cases involving 159,378 substance category entries. In the rural group there were 82,673 exposure cases involving 100,357 substance category entries Overall, the average rank difference was approximately 1.58 with a range of 0-10. Of the substance categories: 21 had a rank difference of 0, 18 had a rank difference of 1, 16 had a rank difference of 2, and 12 had a rank difference of $\geq$3. A rank difference of $\geq$3 was the signal to further evaluate these generic categories.
The top five substance categories were the same between urban and rural groups, with small differences in rank order. The largest differences between the two groups were found among substances ranking in the mid-range for frequency of exposure. Unknown Drugs, Stimulants and Street Drugs, Alcohols, Fume/Gases/Vapors, Automotive/Aircraft/Boat Products, and Antineoplastics were lower rank (more common) in urban counties. Bites and Envenomations, Essential Oils, Lacrimators, Pesticides, Dietary supplements/Herbals/Homeopathics, and Topical Preparations were lower rank in rural counties.
Conclusions: Some associations were expected prior to the analysis. It was expected that the most common generic codes have little difference in rank order, given that these represent a large fraction of the overall calls. Other rank differences in the mid-range were not expected. Since poisoning prevention should focus on exposures relevant to the population, this information can be used to help tailor outreach and education to both urban and rural residents of the state.

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253. The emerging role of the pharmacist in managing poisoning cases: a systematic review

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Background: In 2019, a total of 2,573,180 calls were made to poison control centers across the United States. This equates to 1 exposure every 15 seconds, and of the top 10 agents reported in exposures, 5 were pharmaceutical products or prescription medications. This presents the question, what went wrong in these cases? While many poisoning exposures are accidental, some can be attributed to either a lack of knowledge regarding the proper use of the product or improper storage. With prescription medications listed among the top agents, there is a growing need for pharmacists to prevent, and treat poison exposures.
Objective: The objective of this study was to review the literature and assess the role of the pharmacist in managing poisoning cases. This review aimed to analyze the pharmacist's specific role, associated duties, and necessary skills. A secondary objective was to analyze the literature for common practice sites of pharmacists and describe barriers to participation in poisoning cases.
Methods: A systematic review of the current literature was performed using PubMed and SCOPUS. The search included a combination of terms "pharmacist" and "poisonings." Articles dated 2000 to 2020 were included to reflect most current practice. Articles were excluded if they were not from the U.S., not directly related to poisonings, or if the full text was unavailable. Search results from each database were exported to Microsoft Excel and sorted for removal of duplicate citations. Articles were graded on the Oxford scale based on study design and quality of evidence. Data reported from each article was categorized by: study objective, intervention, practice site, pharmacists' role, and skills needed. Additionally, barriers or challenges to pharmacist participation in poisoning cases were documented.
Results: The search results from PubMed using search terms 'pharmacist' and 'poisonings' yielded 462 articles. The same search terms in SCOPUS yielded 287 articles, after duplicates were removed there was a total of 666 articles. Records were screened and 591 were excluded with 74 remaining to be assessed for full-text eligibility. Ultimately, 36 full-text articles were assessed and utilized. Article types included retrospective analyses, editorials, surveys, and case reports. When examining the literature for the role of the pharmacist; collaboration and education were the most frequently documented roles. Further specified roles included knowledge of antidotes, supportive care, patient presentation of common poisonings, protocol development, and program implementation. Common practice sites included: Poison Control Centers, hospitals, and community settings. Many articles presented opportunities for pharmacists to intervene however, pharmacists must overcome barriers and challenges. These included but were not limited to: lack of toxicology training, limited pharmacist involvement on the healthcare team, and no documentation of interventions.
Conclusions: As drug therapy experts and one of the most accessible healthcare providers, pharmacists can serve a vital role on the healthcare team. Through toxicology training and collaboration with other providers, pharmacists can aid in the treatment of these cases, and in preventing future exposures. In the future, pharmacists should be included in the care and management of poisoning cases.

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254. Toxicological exposures in COVID-19 patients

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Background: The COVID-19 pandemic has been associated with mental health and substance use disorder challenges related to effects of the disease, but also to the mitigation attempts, including but not limited to: isolation due to social distancing, loss of jobs and financial stresses, and decreases in social support structures. The Centers for Disease Control reported in a morbidity and mortality weekly report that symptoms of anxiety and depression increased significantly during the pandemic compared with the prior year. Adverse effects include worsening mental health symptoms, increase in substance use as a coping mechanism and suicidality. We aimed to evaluate patients presenting with a toxic exposure who were also found to have COVID-19 infection.
Methods: The ToxIC Core Registry is a multicenter database of patients cared for at the bedside or via telehealth by medical toxicologists. A new set of COVID-19 specific questions were incorporated into the REDCap database on August 1, 2020. The ToxIC registry was queried from 8/2020-12/2020 for all cases,

including those with reported COVID-19 positive, negative, and unknown testing during their encounter. COVID-19 positive cases were compared to COVID-19 negative and unknown cases. Descriptive analysis was performed for variables including age, sex, and reason for exposure.
Results: From 3,119 toxicological exposure cases submitted after the implementation of new COVID-19 specific questions, 51 cases (1.6%) were positive for COVID-19, 1,397 (44.8%) were negative, and 1,671 (53.6%) had unknown status of COVID-19 during that encounter. Of the 51 COVID-19 positive cases, males accounted for 55% (N = 28) and females accounted for 45% (N = 23). Comparing COVID-19 positive cases (N = 51) and COVID-19 negative cases (N = 1397), the most common reason for encounter for each group was intentional pharmaceutical exposure (56% and 51% respectively). However, intentional pharmaceutical exposures reported as attempt at self-harm was 61.5% for COVID-19 positive and 76.1% for COVID-19 negative patients. In the group of 51 patients presenting with an exposure who were COVID-19 positive, 5 (9.8%) exposures were related to COVID-19 treatment or prophylaxis.
Conclusion: During the last 5 months of 2020, fewer than 2% of cases entered into the ToxIC Registry were COVID-19 positive. COVID-19 negative patients were more likely to have intentional pharmaceutical exposures as an attempt at self-harm than COVID-19 positive patients.

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255. Reaching historically underserved populations using advertisements: a COVID-19 poison prevention campaign

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Background: During routine surveillance in the spring of 2020, poison centers became aware of an increase in exposure calls related to household cleaners, disinfectants and hand sanitizers. Nationally, calls to U.S. poison centers about these product exposures increased by 20.4% and 16.4% when compared to the same period in 2019 and 2018, respectively.[1] Dangerous and unproven COVID-19 treatments and remedies circulated online and high profile poisoning cases made international news. In response, the poison center implemented a multifaceted advertising (ad) campaign to promote awareness of COVID-19-related poison risks and prevention strategies among populations historically underserved by the poison center. This includes Latinx and Spanish-speakers, Asian Americans, Indigenous Americans and people living in US-affiliated Pacific Islands (USAPI).
Methods: We placed English and Spanish ads in five regional publications serving priority populations including Sol de Medianoche (bilingual Spanish paper), Pacific Daily News, Asian Reporter, El Latino de Hoy (Spanish paper), and Smok Signelz (periodical of a Confederated Tribe). We also purchased ads from Facebook.
Results: Print ads (10) published 25 times by five regional publications had an approximate total reach of 300,000 (Sol de Medianoche: 3,000; Pacific Daily News: 72,000; Asian Reporter: 80,000; El Latino de Hoy: 125,000; Smok Signelz: 20,000). Pacific Daily News "poster boards" (2) were viewed 30,000 times. "Text blasts" (6) reached 192,000 Pacific Daily News subscribers. Print ads, "poster boards," and "text blasts" cost a total of $5,472.50. Facebook ads (25) had a reach of 225,723, total user engagement of 26,614, and cost $450. Total estimated reach of the campaign was 747,723 and cost $5,922.50.
Conclusions: Ads published by familiar and trusted sources can connect priority populations with important poison prevention messages and poison control services. Such an approach supports the dissemination of timely messages concerning emerging poison risks as well as corrective messages to rebut inaccurate and dangerous claims pertaining to COVID-19 treatments and remedies. Actual reach of the campaign is likely higher than reported because it does not account for variation in circulation, online readership or small networks of individuals who share a single print copy. While more cost-effective than print ads, Facebook ads only reach those using social media. Using multiple formats—digital, print, text messages and social media—to disseminate messages is important to reach a cross-section within priority populations. We were only able to engage or disseminate information to a limited number of Indigenous Americans and we recommend further study at targeting this population. Further evaluation is needed to better understand audience awareness, message comprehension and any resulting behavior change.

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256. Compounding pharmacies capabilities during succimer shortage

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Background: On January 15, 2021 Recordati Rare Diseases, Inc., released a Dear Health Care Provider letter stating there would be "an interim shortage" of their succimer capsules due to a manufacturing disruption. The company recently estimated that succimer may become available again in August, 2021. Given that (1) succimer is the only chelator approved in the U.S. for lead poisoning, (2) parenteral chelators for lead poisoning are either in short supply (BAL) or very expensive (CaNa2EDTA), and (3) in the late spring through early fall our poison center gets several new cases of lead-poisoned children who have an indication for chelation with succimer, we surveyed compounding pharmacies (CP) in our state to determine which CPs can provide compounded oral succimer capsules (COSC) for a lead-poisoned patient.
Methods: The Center for Medicare Services (CMS) National Plan and Provider Enumeration System (NPPES) was searched for the taxonomy description "compounding pharmacy," limited to the state served by our poison center. Each CP was contacted using the phone number in the NPPES database and asked if they could provide COSC given the background information.
Results: The NPPES returned 53 CPs which met the search criteria. Of the fifty-three, only nine can provide COSC. Of the forty-four that cannot provide COSC, six were closed, six were in long term care facilities or nursing homes, two were in outpatient clinics and the remaining thirty were either unable or unwilling to make COSC.
Of the nine that can provide COSC, only one had the raw material on hand and the other eight said they could obtain the material in 1 or 2 days. The one CP with the material on hand said that they make COSC on a regular basis for several physicians within their Metropolitan Statistical Area. Four of the nine would have the capsules ready the same day the order was placed or next morning if the order was placed late in the day. The remaining five said it would take 1-3 days to have the capsules ready.
Discussion: Given the importance of timely acquisition of certain antidotes and the perpetual drug shortages that plague the pharmaceutical industry, having local CPs with the capability and

willingness to produce COSC is a tremendously important resource to have. Several large CPs in the U.S. have the bulk powder of critically important antidotes on hand, ready for compounding. However, these CPs are more than 1,000 miles away from the state served by our poison center and the time needed to ship the product can negate the benefit of having the bulk powder on hand. Additionally, no hospital in our service area could be found that already has a financial relationship with these distant CPs. Administrative requirements for establishing a financial relationship with a CP would need to be completed before the medication can be ordered, adding additional delay to the process.
Conclusion: Local CPs provide an important alternative source of oral succimer capsules, and possibly other critically needed antidotes, until the FDA-approved commercial product becomes available again.

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257. Alarming Increase in suicidal poisoning cases in 11-14 year old girls handled by poison centers beginning in January, 2021

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Background: From January 21-27, 2021, our poison center detected in real time an increase in the number of self-harm poisoning cases involving girls age 11 to 14 years old that was 2.5 times the average number of cases per day in 2020. This alarming surge was reported to our state department of public health and led us to query nationwide near-real-time poison center toxicosurveillance data to better characterize this event.
Methods: The AAPCC's NPDS data were searched using the inclusion criteria of: (1) any human exposure case, (2) coded as intentional-suspect suicide, (3) ages 6 through 19 years old, (4) occurring between Sunday 12-30-2018 and Saturday 05-15-2021. The data were broken down by (1) the calendar week (Sun to Sat) of the exposure, (2) the age and (3) gender of the patient, and (4) medical outcome of the case.
Results: For the three years studied, calendar weeks 01 began on Sunday January 6, 2019, Sunday January 5, 2020 and Sunday January 3, 2021. Beginning on Week 03 of 2021 (January 17-23, 2021) and continuing through Week 19 (May 09-15, 2021), there has been a significant increase in the number of poison center cases involving self-harm poisonings in all genders ages 11 to 14 years old compared to the same time frame in both 2020 and 2019. Females accounted for 94% of the increase from 2020 to 2021 and 96% of the increase from 2019 to 2021. The total number of cases of 11-14 year old females handled by poison centers during weeks 03 to 19 each year rose from 8,180 in 2019 to 8,076 in 2020 and to 14,345 in 2021.
In 2021, there was a significant drop in the number of cases during Week 11 and Week 13. Week 11 corresponded with spring break for many high schools and colleges while Week 13 included the Saturday of Easter weekend.
The medical outcomes for the 2021 cases involving the 11 to 14 year old females was similar to the outcomes in 2019 and 2020. In 2021, there was a slight increase in the percent of cases with minor clinical effects and slight decrease in the percent of cases with no clinical effect compared to 2020 and 2019.
Discussion: Poison center toxicosurveillance provides near real-time corroboration that teenager suicidality, particularly in younger females, is worsening right now across the entire nation. Incorporating geolocation into the toxicosurveillance may be able to detect "hot-spots" where assistance could be deployed in real time and not in response to an event that occurred months or years earlier.
The primary limitation of this research is that poison center data is passive surveillance. This toxicosurveillance is only detecting a fraction of the actual cases of 11 to 14 year old girls who try to poison themselves.
Conclusion: Our poison center's real-time surveillance found this alarming surge in suicidal self-poisonings in girls 11-14 years old in our state. Near-real-time toxicosurveillance shows this trend is occurring nationwide.

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258. Dramatic and persistent increase of suicidal poisonings in children 6-12 years old managed by poison centers beginning in 2013

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Background: Since in 2010 there has been a significant yearly increase in the number of cases of self-harm poisoning in teenagers 13-19 years old handled by poison control centers. In the past few years, it has seemed that this persistent yearly increase in cases is now happening in children ages 6-12 years old. National poison center data going back to 2000 was searched to characterize the trend in self-harm poisoning cases in the 6-12 year old age group.
Methods: The AAPCC's NPDS database was searched using the inclusion criteria of: (1) any human exposure case, (2) coded as intentional-suspect suicide, (3) involving the AAPCC's "Children" age group (ages 6-12 years old), and (4) occurring since January 1, 2000. The data was broken down by (1) the year of the exposure, (2) the gender of the patient, and (3) medical outcome of the case. For cases resulting in death, the exact age, gender and calendar year were also obtained.
Results: The total number of intentional-suspect suicide cases per year in children fluctuated between 1,195 and 1,936 for calendar years 2000 through 2012. The number of cases per year increased an average of 17.2% per year every year since then, starting from 1,893 in 2012 and rising to 6,666 cases in 2020. The percent of cases involving females was 76.8% in 2012 and rose to 85.9% in 2020. There were 8 deaths from 2000-2012 but 15 deaths from 2013-2020. The ages of the nineteen females who died were 9 years old (1), 10 years old (1), eleven years old (5) and twelve years old (12). The ages of the four males who died were eleven years old (2) and twelve years old (2). The percent of cases with a medical outcome of Major clinical effect rose from 1.9% in 2012 to 2.8% in 2020. The percent of cases with Moderate clinical effects also rose from 17.3% to 22.7% during the same time period.
Discussion: Not only is the number of cases of children attempting to poison themselves increasing at an alarming rate, the severity of these self-poisonings is also worsening as noted by the greater percentage of cases with a Major or Moderate clinical outcome. Poison center toxicosurveillance is near-real-time surveillance, but it is passive surveillance and does not capture many cases of children trying to poison themselves. The absolute numbers of cases of children poisoning themselves is greater than what is recorded in the NPDS database so the results presented here are only the tip of the iceberg for what is actually occurring in this country. This also does not take into account other methods by which children are trying to hurt themselves.

Conclusion: Poison center cases involving children trying to poison themselves increasing by 250% from 2012 to 2020 clearly demonstrates the severity of this public health issue.

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259. Congenital methemoglobinemia

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Background: Methemoglobinemia occurs when the iron moiety in hemoglobin is oxidized from the ferrous to the ferric state. Methemoglobin is unable to effectively bind or deliver oxygen to tissues. Methemoglobinemia may be congenital or acquired. While neonatal methemoglobinemia is often congenital, cases in older children and adults are typically caused by exposure to exogenous oxidants. Benzocaine, dapsone, nitrites, nitrates, and aniline dyes are common agents which cause methemoglobinemia. Methemoglobinemia may also occur from oxidant stress during severe infections. Congenital causes of methemoglobinemia include hemoglobin M disease, cytochrome b5 deficiency, and cytochrome b 5 reductase (CYB5R) deficiency. Normally, methemoglobin is constantly being formed at a low level. CYB5R is the enzyme reduces it back to hemoglobin. Type 1 CYB5R deficiency affects RBC's only, whereas type 2 affects all cells. Patients with type 1 may exhibit baseline normal circulating Methgb fractions, but are predisposed to developing methemoglobinemia when exposed to oxidant stress.
We report an adult patient who presented with hypoxia and elevated MetHgb fractions suspected to be due to an occupational exposure. He was subsequently found to have *Legionella* pneumonia and type 1 CYB5R deficiency. Methemoglobinemia in this case was likely caused by the underlying enzyme deficiency and the oxidizing stress of his infection.
Case report: A 23 year old male with a history of alcohol abuse and prior COVID presented with fever and cough three days having worked with paint thinner at his job. On presentation, he was febrile to 100.4F and hypoxic with SPO2 85% on room air. His chest x-ray showed a right lower lobe consolidation, and he required 40 liters/min high flow nasal cannula oxygen support. His blood was noted to be dark brown when it was being drawn for an ABG, which raised concern for methemoglobinemia. Analysis showed a methemoglobin level of 27.8% and CoHgb 7.1%. Methylene blue was administered. The methemoglobin level initially declined to 0.7 %, but then rose to 5%, raising suspicion of a congenital enzyme deficiency. Testing was sent for G6PD enzyme activity, CYB5R enzyme activity, and hemoglobin electrophoresis. Additional history for potential external exposure was assessed including environmental exposures, drugs, and diet, but nothing was found. Test results eventually revealed a homozygous abnormality in the CYB5R3 gene, along with *Legionella* pneumonia.
Discussion: Initially, we suspected the patient's methemoglobinemia was caused by exposure to paint thinner, which contains some oxidant components. However, his exposure was limited, and occurred in an outdoor area, so significant toxicity was unlikely. Since the symptoms presented three days after this minimal exposure, and then rebounded after methylene blue therapy raised concerns for an underlying congenital cause. It is possible that the paint thinner played a role in this susceptible patient's methemoglobinemia, but it was more likely due to oxidant stress from severe pneumonia in the setting of congenital CYB5 reductase deficiency.
Conclusion: Congenital methemoglobinemia is a rare disease. It is imperative to consider enzymatic testing to rule out congenital causes if methemoglobinemia does not resolve expeditiously with treatment, or when exposure to an external oxidizing agent is unlikely.

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260. Skeletal fluorosis

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Background: Skeletal fluorosis (SF) is a chronic metabolic bone disease with a world-wide prevalence of 4.8-47.5% based on the geographical area. Factors that increase risk of SF include excessive fluoride oral intake from water, prolonged fluoridated gas inhalation, excessive consumption of fluoridated toothpaste. In this case we discuss skeletal fluorosis after excessive mouthwash use.
Case report: 64 years old male with a history of depression, pulmonary fibrosis, hepatitis C, and hypothyroidism. He was followed by the outpatient clinic for significant unexplained weight loss. computed tomography scan of chest/abdominal and pelvis showed diffuse sclerosis of the axial skeleton. Oncological, orthopedic, rheumatologic, and endocrinologic workup was negative. Further imaging with a whole bone scan showed the possibility of diffuse radiotracer uptake throughout the skeleton. Differentials included metastatic disease, metabolic bone disease, and myelofibrosis or myelosclerosis. After an unrevealing workup, a urine fluoride level was obtained and it was elevated to 14.40 (normal level= 0.20-3.20 mg/L). Subsequent investigation discovered use of mouthwash contains sodium fluoride 0.02% (0.01% w/v fluoride ion). The patient rinsed with mouthwash up to 20 times per day without overt ingestion.
The poison center was consulted. There is no specific treatment for chronic fluorosis other than discontinuation of the agent. Repeat fluoride level in 6 weeks was also recommended.
Discussion: There are several types of fluorosis such as dental, skeletal, and non skeletal. In this case, we discuss chronic exposure to mouthwash containing fluoride that resulted in SF. Fluoride is mainly absorbed through the gastrointestinal and respiratory tracts. It can enter the skeleton and have a half-life up to 7 years. By entering the skeleton, fluoride can alter the bone strength by either incorporating in the hydroxyapatite crystals as a replacement for the hydroxide ion or by influencing the bone turnover and increase the osteoblast activity. This increase risk of osteoporosis and osteocondensation fracture.
Skeletal fluorosis may be asymptomatic in early stage but can lead to joint pain, lower back pain, stiffness and rigidity in the joints, and restricted movement of spine. Also, it can cause bone deformities and increase the risk of fracture. In severe cases, flexion deformities of spine and other neurological complications may occur. Our patient has no skeletal symptoms findings. Most cases of SF are diagnosed with radiological finding. Characteristic imaging finding for SF include diffuse osteosclerosis, osteophytosis, and ligamentous calcifications. In our patient, the CT finding of diffuse skeletal sclerosis resulted in obtaining fluoride urine level after ruling out other differential diagnosis such as hyperparathyroidism, hyperthyroidism and metastases bone disease.
Conclusion: Skeletal fluorosis is a rare chronic bone and joint disease. Excessive using mouthwash-containing fluoride with swish and spit only can result in skeletal fluorosis.

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261. The introduction of SBIRT training in substance use disorder education in emergency medicine curricula

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Background: The Emergency Department is considered a front-line for the treatment of patients with Substance Use Disorder (SUD) including opioid use disorder (OUD) and as such, emergency physicians play a critical role in the identification and treatment of patients with SUD, and in decreasing the cost and burden of SUD on individuals, families, and society. Despite this, the training and education on the screening and assessment of SUDs for most emergency medicine residents is still very limited and is not standardized. With funding from the Substance Abuse and Mental Health Association (SAMHSA), ACMT created the Substance Use Screening Approach in the ED (SUSTAIN-ED) Classroom, which offers online SUD learning to emergency medicine residents through a 4 hour tailored asynchronous curriculum utilizing the "screening, brief intervention, and referral to treatment" (SBIRT) strategies. The training also contains several modules on the treatment of opioid use disorder, and other topics such as pregnancy and opioid use. Research question: Can the development of a SBIRT modeled training on SUD in the SUSTAIN-ED classroom engage Emergency Medicine residents?
Methods: A four hour asynchronous training was developed by ACMT on the screening, assessment, and treatment of substance use disorder. The faculty consisted of 11 medical toxicologists with expertise in this area. The training was housed in a learning management system (LMS) which facilitated tracking of all participants. Over a two-year period, we recruited 22 emergency medicine residency programs across the United States to participate in this pilot program. One emergency medicine faculty from each residency program acted as a site lead to facilitate resident participation. As part of the grant requirements, test items on this curriculum were developed for the emergency medicine board certification exam and were provided to the American Board of Emergency Medicine.
Results: The program was launched in March 2020 (which happened to coincide with the onset of the COVID-19 pandemic). One thousand and ninety-seven residents were eligible to participate in this program. In total, 556 (51%) of residents completed the training. Resident completion varied from 15 to 100 percent depending on the program. An additional 120 (11%) of residents enrolled in the program are in the process of completing the training. When asked: "I expect this event to benefit my professional development and/or practice" over 90% of residents stated that they agree. When asked: "I will use the information gained from this event to change my current practice" over 80% of residents agreed.
Conclusion: More than half of the residents from 22 emergency medicine programs completed this SBIRT training curriculum. This occurred despite competing clinical priorities for the emergency medicine resident during the SARS-CoV-2 pandemic. The residents that completed the training noted a high level of satisfaction with the content and its applicability to their practice.

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262. Knowledge acquisition among emergency medicine residents after completion of an asynchronous substance use disorder training program

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Background: The training and education on the screening and assessment of SUDs for most emergency medicine residents is very limited and is not standardized. ACMT created the Substance Use Screening Approach in the ED (SUSTAIN-ED) Classroom, which offers online SUD learning to emergency medicine residents through a 4 hour tailored asynchronous curriculum utilizing the "screening, brief intervention, and referral to treatment" (SBIRT) strategies. Twenty-two emergency medicine residencies participated in this program. Each course contains a pretest and posttest evaluation that residents are required to complete as well as an evaluation through the funders data collection tool.
Methods: The SUSTAIN-ED curriculum consisted of 13 lectures delivered within 5 courses (substance use disorder 101, screening and assessment, treatment-opioids, treatment-other treatments, and other key issues). Pretest and posttest multiple choice questions were developed for each lecture. Each question had a single correct answer. Pretest and posttest scores from those that completed the training were analyzed.
Results: In total, 556 (51%) of residents completed the training. For the opioid course, scores increased from 49% on the pretest to 82% on the posttest. Likewise, the screening and assessment course scores increased from 51% to 72%, the other treatments course scores increased from 65% to 85%, the cannabinoids, stimulants and benzodiazepines course scores increased from 49% to 82%, and the scores for the course on substance use disorder 101 increased from 82% to 92%.
Conclusion: An analysis of posttest scores compared to pretest scores demonstrates that the residents' knowledge increased considerably as a result of taking the training. Posttest scores increased by more than 20% for each course taken. Knowledge acquisition significantly improved among emergency medicine residents after the SUD training.

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263. Influence of the 2020 novel coronavirus (SARS-CoV-2) on toxicology related presentations

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Background: 2020 presented an unprecedented global health crisis, novel Coronavirus (COVID19). Growing concerns of the impact of public health interventions on mental health, changes in childcare/school attendance, and rapid influx of constantly changing information on what is truly safe and effective for treatment or prevention of the virus, is hypothesized to influence the number of toxicology exposures. This study aimed to examine these aspects of the global pandemic affecting presentations to a medical toxicology service compared to the previous year.
Methods: Retrospective, single-center, cohort study conducted at University of Illinois Hospital in Chicago, IL. Data collected from

1/24/2020-12/31/2020, reflecting the timeline of COVID19 in Illinois through end of 2020, with 2019 comparison group.
Inclusion criteria were documented medical toxicology consult, and overdose or other acute intoxication as part of the chief complaint. Data collection included: demographics, past medical history, and information related to the patients' admission. The primary outcome was the difference in number of medical toxicology presentations in 2020 compared to 2019. Secondary outcomes included: difference in number of toxicology related cases due to potential COVID19 treatments, how city/statewide public health mandates influenced presentations, and the number of patients requiring psychiatric consultations. All data were analyzed using descriptive statistics, Chi Squared or Fischer's Exact tests for categorical data and Mann-Whitney or T-tests for continuous data.
Results: Fifty three patients were seen by the medical toxicology service in 2020, compared to 90 patients in 2019, a decrease in toxicology related cases between the 2 years. This decrease may be secondary to multifactorial effects COVID19 had on the population. There were less overall psychiatry consults in 2020 versus 2019 (52.8% vs. 64.4%), but a greater percent of patients were discharged to psychiatric facilities in 2020 than 2019 (32.1% vs 28.9%). There was an increase in accidental ingestions in 2020, compared to 2019 (18.9% vs 11.1%). A higher level of acuity was seen in 2020 versus 2019, with 43.4% of patients in 2020 requiring ICU level care versus 30% in 2019. Patients on average had longer lengths of stay in 2020 compared to 2019, 13.6 days vs 1.2 days respectively. These results suggesting that patients were not seeking care unless severe or unmanageable symptoms were developing.
Conclusions: These results reflect COVID-19's impact on emergency department visits and hospital admissions overall, as evidenced by the decreased number of patients seen in 2020 compared to 2019. The patients that were seen had more severe medical issues compared to 2019, with a higher percent of patients requiring ICU level of care. It also highlights the COVID-19 impact on mental health, as more patients required discharge to psychiatric facilities in 2020. There was also a higher percent of accidental ingestions in 2020, reflecting more time spent at home during the pandemic. Overall, this research demonstrates that the COVID19 pandemic influenced the number and types of patients seen by a medical toxicology service. This research also highlights the severity of these patients, both in mental and physical health, and the amount of healthcare resources needed by these patients.

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264. Trends in gamma-hydroxybutyrate (GHB) and related compounds use reported to a major poison control system: a retrospective review from 2010 to 2020

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Objective: To analyze demographics, outcomes, and trends in gamma-hydroxybutyrate (GHB) and related compounds cases reported to a poison control system from 2010 to 2020.

Methods: This was a retrospective review of GHB and related compound cases reported to a poison control center (PCC) between Jan 1, 2010 and December 31, 2020. Inclusion criteria was cases of GHB and related compounds (e.g sodium oxybate, phenibut, 1,4-butanediol, gamma-butyrolactone). All ages and both sexes were included. Exclusion criteria were cases that did not include GHB or related compounds, unknown/questionable ingestions, remote ingestion without current symptoms, and incomplete cases. We evaluated generalized outcomes per AAPCC criteria stratified as no effect, minor, moderate, or major and deaths. We documented specific symptoms and interventions noted by the poison specialists, intent of ingestion, and presumed or known substance ingested.
Results: A total of 509 patients were included over the 10-year period (2010-2020), 153 cases were excluded. There were 341 male cases, 167 female cases, and one unknown gender. The mean age was 34.2 years old and range was 8 months to 88 years old. The age distribution was 1.6% 0-9 years old (n = 8), 4.9% 10-19 years old (n = 25), 30.8% 20-29 years old (n = 157), 30.3% 30-39 years old (n = 154), 21.2% 40-49 years old (n = 107), 7.5% 50-59 years old (n = 38), 1.6% 60-69 years old (n = 8), 0.2% 70-79 years old (n = 1), 0.4% 80-89 years old (n = 2), and age unspecified was 1.6% (n = 8). There were 35.1% (n = 179) major effect, 39.7% (n = 202) moderate effect, 13.4% (n = 68) minor effect, 8.3% (n = 42) minimal effect, 3.3% (n = 17) no effect, and one death. Of note, 36.3% (n = 185) were intubated and 8.6% (n = 44) were due to withdrawal. Coingestants were involved in 43% (n = 222) of reported cases.
Conclusions: A majority (~75%) of our cases resulted in major or moderate effects, with only one death reported. Of note, 36% were intubated and 43% involved reported coingestants. Thus, clinicians should be aware that patients who ingest GHB or analogs may present in extremis, may warrant intubation, and may be intoxicated with several substances. The peak use is in the third to fifth decades of life. Withdrawal symptoms with chronic use were responsible for 8.6% of cases, and on further analysis was noted to be poorly responsive to benzodiazepines.

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265. Patterns of naloxone use reported to the US poison centers

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Background: As the number of deaths from opioid overdose has grown over the last two decades, several states have passed laws expanding public distribution of naloxone. The objective of this study is to evaluate the trends and characteristics of the cases reported to US poison centers (PCs) where naloxone was being recommended or utilized as therapy with focus on the role of the PCs in making the initial decision on naloxone administration.
Methods: Exposures where naloxone therapy was "Recommended and/or Performed" from 2014 to 2020 were included for the analyses. Patterns of naloxone use reported by ACH was evaluated in a sub-analysis. Descriptive statistics were used to analyze the demographic and clinical characteristics of naloxone reports. Poisson regression models were used to evaluate the trends in the rates of naloxone reports (per 100,000 human exposures). The percentage changes and corresponding 95% confidence intervals (95%CI) during the study period were reported.

Results: Overall, there were 182,430 exposures that reported naloxone therapy to the U.S. PCs during the study period. The number of naloxone reports increased from 22,275 cases in the year 2014 to 28,684 cases in 2020. Among these cases, 82.6% were reported from acute care hospitals and emergency departments (ACH), with the proportion of such calls demonstrating a decrease from 85.7% to 75.3% during the study period. In majority of the cases, naloxone was utilized prior to PC recommendation, both in total cases and cases from ACH (81.2% and 81.8%, respectively). Females accounted for 50.3% of the cases. Single substance exposures accounted for approximately half of the cases. The most frequent reason for exposure among this population was suspected suicides (46.5%), with intentional abuse causing 26.5% exposures. Moderate clinical effects were seen in 46.2% cases, while major clinical effects accounted for 30.2% of the sample. The case fatality rate in this sample was 1.7% with 3.059 deaths. Drowsiness and lethargy (43.4%) and respiratory depression (28%) were the most commonly seen clinical effects. Characteristics of patients and exposures reported from ACH demonstrated similar patterns. The most frequent opioid reported for exposures overall and from ACH were heroin (13.4% and 14.1%, respectively) and oxycodone (7.1% and 11.4%, respectively), while benzodiazepines (20.1% and 22.5%, respectively) was the most common non-opioid substance causing toxic exposures. The frequency (28.7%, 95% CI: 19.6% - 36.7%, $p < 0.001$) and rate of naloxone reports overall (31.2%, 95% CI: 22.3% - 40.7%, $p < 0.001$). The rate of exposures reported by ACH increased by 15.1% (95% CI: 12.1% - 19.7%, $p = 0.02$).
Conclusions: Analysis of calls to U.S. PCs indicated an increasing trend of naloxone use as therapy prior to any recommendations from the PCs. The majority of cases demonstrated moderate and major clinical effects. Calls from ACH decreased, suggesting a greater use of naloxone in the general population. PC services can play a key role in ensuring the overall safety and efficacy of naloxone intervention.

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266. Changes in pediatric ocular hand sanitizer exposures reported to poison centers during the COVID-19 pandemic

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Background: Due to the SARS-CoV-2 (COVID-19) pandemic that started in late 2019, recommendations were made that people clean their hands with hand sanitizer if soap and water were not readily available. Consequently, hand sanitizer exposures reported to poison centers increased. Some of these exposures occurred via the eye. Although generally not considered serious, ocular hand sanitizer exposures involving children may be of particular concern to parents. The objective of this study was to describe pediatric ocular hand sanitizer exposures during the COVID-19 pandemic and compare them to exposures during previous years.
Methods: Cases were exposures to hand sanitizer (Generic codes 0200613, 0200614, 0200615, 0200616) reported to the National Poison Data System (NPDS) during 2018-2020 where the exposure route was ocular and the patient age was 0-19 years. The distribution of cases during 2020 was determined for various factors, and comparisons were made to the previous two years by calculating the difference in percent change between 2018 and 2020, and between 2019 and 2020.
Results: A total of 1498 pediatric ocular hand sanitizer exposures were reported during 2020. These data were compared to exposure rates in 2018 and 2019.
Conclusions: The number of pediatric ocular hand sanitizer exposures during 2020 was higher than that during 2018 and 2019. The highest percentage increases were seen with patients age 0-5 years, males, and exposures that occurred in the public area. The number of exposures at school declined, possibly because in-person classes were curtailed or cancelled. The percentage increase was greater for serious cases than for cases that were not serious.

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267. The relationship of serum calcium to markers of ethylene glycol poisoning: does serum calcium help make the diagnosis?

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Background: The diagnosis of ethylene glycol (EG) poisoning can be challenging. Serum EG concentrations are not routinely available and empiric treatment for suspected EG toxicity is often based on surrogate tests including pH, serum electrolytes, anion gap, and serum osmolality. Hypocalcemia is suggested as a clue to suspected EG poisoning due to the metabolic transformation of EG to oxalic acid and subsequent formation of calcium oxalate crystals. In a previous retrospective study, hypocalcemia was not a common finding of EG poisoned patients, even in those with an anion gap metabolic acidosis. The aim of this study was to further evaluate the utility of serum calcium in patients who have ingested EG; specifically, to determine the correlation of serum calcium to markers of EG poisoning (pH and serum creatinine).
Methods: This was an observational study evaluating all patients called into two poison control centers (PCCs) from September 2017 through April 2021. Only patients with confirmed blood EG concentrations (> 5 mg/dL) were included. Routine demographic data were collected. Requested laboratory results from the first specimens collected at the hospital included: EG blood concentration; total calcium; albumin; ionized calcium; serum creatinine; serum bicarbonate; blood gas; anion gap; and presence of calcium oxalate crystals in urine. The correlation of initial serum calcium to markers of EG poisoning (i.e., pH and serum creatinine) was assessed for presence of associations.
Results: There were a total of 80 subjects with confirmed EG poisoning in this study. Of these patients, only 51 had both a pH and total calcium documented and only 53 had both total calcium and creatinine documented for analysis. There were insufficient cases to compare ionized calcium to pH. There was no correlation observed between total calcium and serum pH (Pearson correlation coefficient $r = 0.012$, $p = 0.850$) There was a modest but not statistically significant correlation between serum creatinine and calcium (Pearson correlation coefficient $r = -0.357$, $p = 0.088$)

Conclusion: In the setting of confirmed EG ingestion, hypocalcemia does not appear to be correlated with pH and creatinine, markers of EG poisoning. As an observational PCC study, many cases lacked complete data and some cases of EG poisoning may have been excluded due to lack of confirmatory EG testing. A larger, prospective study is needed to make definitive conclusions.

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268. Lead toxicity in female buckshot victim of childbearing age: a treatment conundrum

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Background: Lead toxicity has been described as a complication seen in victims of gunshot wounds. As fragmented bullets or pellets remain imbedded in the tissue, heavy metals are leached from the projectile and distributed throughout the body. Here we describe a case report of a 33-year-old female who experienced a gunshot wound with buckshot to the right elbow, chest, and abdomen to highlight the effects of lead poisoning and treatment alternatives in a woman of childbearing age.
Case report: A 33-year-old woman sustained a gunshot wound to the right elbow, chest, and abdomen resulting in deposition of pellet fragments within her elbow joint, soft tissues, chest and abdomen. She was managed surgically with an attempt for elbow reconstruction and complete removal of pellets being unsuccessful due to presence of innumerable fragmented pellets. One month after surgery, the patient reported fatigue, irritability, headaches, vertigo, decreased memory, and concentration. Blood lead levels were found to have increased to 57 mcg/dL from 36 mcg/dL three weeks prior. However, hematologic parameters were within normal limits. Removal of pellet fragments and preoperative chelation therapy was recommended to prevent manipulation-related increase in lead levels following surgery. Following chelation therapy, the patient's blood lead concentration decreased to 25 mcg/dL. Three months post-surgery, her blood lead levels increased to 48 mcg/dL and chelation therapy was administered due to continuing neuropsychiatric symptoms. The patient's last documented blood lead concentration was of 32 mcg/dL and she continues conservative management as an outpatient in clinic.
Discussion: While occupational lead exposure guidelines as set by the American Conference of Governmental Industrial Hygienists recommends keeping adult workers measured blood lead values <30 mcg/dL; the Center for Disease Control and National Institute for Occupational Safety and Health recommends 5 mcg/dL as the definition for an elevated blood concentration for adults and children. This is relevant because the affected patient is a female of childbearing age. When absorbed, lead is distributed to all tissues but approximately 90% is deposited in bone where the half-life is on the order of years. Studies demonstrate that pregnancy and lactation are associated with increases lead release from the maternal skeleton when the mother has experienced lead exposure. High levels of lead in women's bones at the time of childbirth correspond to lower birth weight, weight gain, and reduced head circumference and birth length. Treatment in pregnant patients is focused on removal of the exposing agent as chelating therapy is contraindicated. Therefore, surgical removal of retained pellets is an approach to be considered in the setting of lead toxicity secondary to retained bullet/pellet fragments in women of childbearing age. Although the patient expressed no desire to become pregnant, she was informed about associated complications of lead toxicity in pregnancy.
Conclusion: This case report represents a treatment conundrum in female patients of childbearing age that have chronic lead toxicity due to retained lead fragments secondary to gunshot wounds. This case showcases that although surgical removal of lead fragments is recommended in this setting, the extent of fragmented bullets may make this approach a difficult one.

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269. The reporting and management of adverse vaccination events to COVID-19 vaccines using a dedicated helpline by a state poison center

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Background: Vaccines can be associated with adverse effects which are sometimes severe. These adverse effects need to be managed and in the case of those that are severe enough, also reported by the vaccinator to the Vaccine Adverse Event Reporting system (VAERS). For a large event, this post-vaccination management and reporting duty requires an organized mechanism with secure record keeping and resources to follow up on case outcomes and FDA requests. Additionally, while the adverse event incidence from Phase 3 studies is reported for vaccines, the incidence of people calling to report adverse effects or requiring management assistance may vary based on other variables such as the type of adverse effect or news events. This information would be critical for allotting resources for future mass vaccination events. On 1/8/2021, a vaccine adverse event helpline was established by a State poison center in cooperation with its parent healthcare system.
Methods: Retrospective review of one poison center's database of exposure cases of three COVID-19 vaccines (Moderna, Pfizer and Janssen) from the start of line activation and case template adoption (1/8/2021) until 4/20/2021. Patient's age, vaccine type, which vaccine dose (1 or 2), and symptoms were determined by one trained abstractor; the healthcare system's electronic medical record was utilized when data elements were missing. The number of courses of each vaccine administered by the healthcare system during that time was obtained from official reports. To assess the effect of news of the pause on the Janssen vaccine, the number of Janssen cases reported from 4/13 thru 4/20 was compared to the number of cases reported from 4/5 thru 4/12.
Results: From 1/8/2021 through 4/20/2021 there were 1639 cases reported with Pfizer representing the most with 930 cases (0.54%) but Moderna had the greatest percentage (1.44%, chi^2 $p = 0.00$). The mean age was 57.8 years and 75.8% of the cases were females. The most common symptom reported was muscle aches (38%); nausea (18%), erythema (10%), and pruritus (9%) were more commonly reported in females. There were 48 VAERS reports submitted with one follow up case requiring detailed medical records provision to the FDA. During the period of 4/5/21 to 4/12/21 there were 47 calls regarding the Janssen vaccine, this increased 89% over the next week to 89 calls following the FDA temporary halt to its use.
Conclusions: Poison centers can track reports of symptoms and manage potential adverse vaccination reactions from a mass vaccination event while maintaining a VAERS reporting system. It appeared that females reported adverse effects by a factor of 3

to 1, but most reported symptoms were generally the same between genders. Moderna had the highest rate of reported adverse events. Cases may increase following events that question the safety of the vaccine. For future mass vaccination events, poison centers may be utilized to provide key elements of the process.

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270. Accidental & non-accidental ocular exposures during COVID: a comparative data analysis for a single state using the National Poison Data System

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Background: Chemical exposure to the orbital and periorbital areas can cause destructive oxidative damage to the anterior segment, cornea, & adjacent ocular tissue. Alkaline corrosives are among the most likely to cause irreversible ocular damage and blindness due to liquefactive necrosis and subsequent ability to penetrate through the surface of the eye. Acids such as bleach and swimming pool chemicals are relatively less safer but still have potential to inflict harm. Accidental & non-accidental ocular exposures are characterized in few studies using the National Poison Data System (NPDS). This study highlights dramatic changes in incidence rates of ocular exposures as stratified by age and implicated substances during the COVID pandemic reported to the poison center network in a single state.
Methods: This retrospective cohort analysis of NPDS data allowed for comparative analysis of incidence rates during the United States COVID pandemic as compared to the prior 5 years by utilizing de-identified human ocular exposure calls to the poison center network in a single state. The COVID timeline is inclusive of dates ranging from January 1, 2020 to December 31, 2020. Baseline incidence rates acting as a comparison to the COVID pandemic are between January 1, 2015 to December 31, 2019.
Results: A total of 6,535 person-years were evaluated in 2020, representing an annual rate of 20.3 cases per 1 million residents, as compared to 31,699 person-years in the prior 5 years (annual rate 19.9 per million). By age, 35.04% (N = 2,290) of cases afflicted those between the ages of 0-19 years, 35.8% (N = 2,342) of cases between 20-69 years, and 3.21% (N = 210) of cases aged 70+ years. By substance, bleach (liquid hypochlorite) represented the number one culprit of ocular exposures during the COVID pandemic, followed by gasoline, laundry pods, glow sticks, and hand sanitizer (ethanol based) with incidence rates of 4.06%, 1.79%, 1.55%, 1.44%, and 1.30%, respectively. In the prior 5 years (2015-2019), bleach represented the 4th most common cause of ocular exposure (1.35%), while gasoline remained the 2nd most common (2.38%).
Conclusions: During the COVID pandemic, the number one culprit of ocular exposures in our state was bleach, up from 4th most common in the prior 5 years. In addition, gasoline remains the 2nd most common agent for ocular exposures during COVID and the prior 5 years. Pediatric patients and adults aged 20-69 years were at highest risk, and elderly people age 70+ were at much lower risk. During a viral pandemic, it would be prudent to educate the public on safe use of household cleaning agents to help avoid accidental ocular exposure.

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271. Procuring a professional marketing firm for digital poison center awareness

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Background: In the past few decades, people have dramatically changed the way they access information. Digital advertising success has continued to rise compared to traditional methods and people increasingly access health information digitally. To raise awareness of poison center services it is vital to increase digital visibility. The goals of this project were to increase awareness of the poison control center (PCC) and to increase the PCC social media engagement and followers. The target audience for this project was parents of young children in the PCC service area.
Methods: The PCC received a grant to use on digital marketing. Qualitative data was collected from PCC educators and local health department educators with experience working with marketing agencies. Understanding others' experience allowed the PCC to effectively search for an agency that could best meet the PCC needs. After identifying a marketing firm, it was vital that the agency understand the unique focus and needs of the PCC and project goals before beginning the creative process. This was accomplished at in-person meetings and email correspondence with the agency. The agency presented ideas including messaging and images to the PCC for feedback. After adjustments, the creative collateral and timing for the campaign was approved. The expertise of the agency on what, how, when and where to advertise was vital and was virtually outside the PCC expertise. Platforms for promoting the ads were Google, Facebook, and Instagram. The agency fully managed the campaign and sent weekly reports to the PCC. The ads ran from November 2019 to June 2020. At the conclusion of the ad campaign, a final meeting with the agency was held and a final report was provided.
Results: Data for the full date range showed that the ad content was displayed 5,585,773 on social media, and clicked on 7,585 times. The click through rate (CTR) on average (how well the ads performed) was 0.14%. The CTR had a relatively steady increase each month the agency ran the ads. The average cost per click was $0.74. The PCC had a 329% increase in new Facebook page likes during the campaign, compared to the same number of days the previous year. The number of engaged users increased by 306%, or 5,702 users. The number of people who clicked on the PCC's Facebook content was 5,503, which showed a 3,118% increase when compared to the same time period the previous year. The ads were displayed on Facebook 1,853,892 times, and were viewed 124,355 times. There was a 275% increase in PCC's post engagement (likes, comments, shares).
Conclusion: Data shows that the digital ads did delivered PCC information, thus raising awareness of the PCC to a much larger audience than previous efforts. When determining ways to reach a target audience, PCC's should consider using funds to procure a marketing firm to create and manage digital media campaigns. Utilizing experts in the marketing field can have a positive impact on poison center education and help meet education goals.

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272. National surveillance and prevention strategies for carbon monoxide exposures

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Background: Carbon monoxide (CO) is the leading cause of poisonings globally and the most frequent cause of accidental poisoning during pregnancy. In utero, CO exposure can contribute to adverse pregnancy conditions and fetal demise (Culnan et al., 2018). At the national level, the Centers for Disease Control and Prevention (CDC) relies on a network of surveillance sources to monitor and collect CO exposure and fatality data. The purpose of this study was to review select surveillance data systems (1999-2019) and identify available resources and reports of CO exposures and fatalities.
Methods: A total of 3 national surveillance data systems were reviewed (1999-2019) for CO-related exposures in the general population and pregnant women: 1) The American Association of Poison Control Centers National Poison Data System (NPDS) which captures and publishes exposure and poisoning data from its 55 nationwide poison control centers (PCC); 2) The CDC National Vital Statistics System (NVSS) which captures information regarding underlying causes of CO deaths; and 3) The US Department of Housing and Urban Development's American Housing Survey (AHS) which reports the number of housing units with the presence of a functioning CO detector. Specific information reviewed in this study included demographic information, pregnancy status, chronicity, route, and intent of CO exposure, underlying and multiple causes of death, and presence of functioning CO detectors in dwelling units.
Results: From 1999 to 2019, NPDS reported a total of 314,856 CO exposures, and 1,192 fatalities (30.2% female; no pregnant women). The top three exposure reasons for fatality cases included unintentional environmental (50.40%), environmental (21.3%), and intentional suicide (17.80%). During the same study period, NVSS reported 31,770 CO-related deaths (23.1% female), which included 19 pregnant women (73.7% accidental self-poisoning, 26.3% intentional poisoning). Exposure reasons for NCSS reported fatality cases included accidental poisoning (27.6%), intentional self-poisoning (69.2%), and other causes (3.3%). According to AHS, at the national level, households with a working CO detector increased from 30.0% in 2007 to 68.2% in 2019. As of 2018, only 33 states have CO detector policies for dwelling spaces, facilities, schools, and community centers .
Conclusions: Over the 21-year study period, CO exposures were reported in over 300 thousand PCC cases; and over 30 thousand deaths in the United States. Such significant numbers of CO poisonings and fatalities may be reduced by effective educational tools and policy guidelines, especially those promoting installation of functioning CO detector (Graber et al., 2007; The Carbon Monoxide Poisoning Prevention Act of 2010). The current study also found reporting discrepancies between select national CO surveillance sources for exposures, fatalities, and intent in the general population and pregnant women. A unified national CO surveillance system would accurately capture the full scope of CO exposures and fatalities in the general population as well as in different subpopulations.

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273. Assessment of a virtual medical toxicology rotation based in a poison control center: how effective is it?

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Background: Medical toxicology (MT) is a core part of the Accreditation Council for Graduate Medical Education Emergency Medicine (EM) curriculum. There are multiple toxicology questions on the American Board of Emergency Medicine certification examination. We offer a Poison Control Center (PCC)-based MT rotation designed to teach EM core topics. We present an evaluation of our virtual MT rotation which was developed to comply with SARS-CoV-2 pandemic restrictions.
Methods: Virtual teaching was conducted via Health Insurance Portability and Accountability Act compliant secure WebEx rooms. Participants were enrolled in a 2- or 4-week rotation. Previously, our PCC had an in-person rotation during which rotators participated in PCC open case follow-ups which were staffed with a MT fellow, didactics (core lecture series, regional toxicology conference, and journal club), and cased-based afternoon teaching rounds with faculty. We restructured this rotation to a virtual format. We eliminated case follow-ups and instead provided small-group teaching from the MT fellows on core topics, converted to primarily interactive lecture-based discussions afternoon teaching rounds with MT faculty, and required all participants to present short individual PowerPoints on assigned MT topics. Participants still attended didactics virtually. Impact and effectiveness of the rotation, and utilization of PCCs was evaluated with pre- and post-rotation surveys.
Participants were surveyed via email in the first week of their rotation ("PRE") and last week of their rotation ("POST"). SurveyGizmo was the platform used to collect data; participation was voluntary. This study was determined to be IRB exempt by our institution. Data are presented as descriptive only.
Results: There were 79 PRE and 68 POST responses collected from October 2020-May 2021 from 198 participants from 4 different states and Canada. Most respondents were EM residents (71%). This survey also included residents/fellows from Internal Medicine, Pediatrics, and Pediatric EM. Respondents were primarily PGY-2 (23%) and PGY-3 (34%). 85% of participants reported seeing a toxicology patient every shift, at least once a week, or once a month. Pre-rotation, 21% reported they never routinely contact a PCC, 53% sometimes, and 23% frequently. The participants reported the main reasons for calling a PCC included case severity (65%), and uncertainty about case management and diagnosis (63%). Reasons for not calling a PCC included time required (18%), and feeling that they could manage the patient without a consult (37%). Post-rotation 75% felt they would be "highly likely" and 22% "somewhat likely" to call the PCC for their toxicology cases.
Based on the PRE, 83% felt "competent" or "somewhat competent" managing toxicology cases; based on the POST, 97% felt "competent" or "somewhat competent". The highest yield parts of the rotation were ranked as "afternoon teaching rounds with the faculty" (52%) and "direct fellow interactions" (35%). Finally, based on the POST, 93% would be "very likely" or "somewhat likely" to recommend our virtual rotation, with 90% finding the rotation "very effective" or "effective."
Conclusion: Based on this survey study, our virtual MT rotation appears to improve participants' perception of their competence in MT and could improve PCC reporting.

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274. Survey of poison control center secure healthcare application messaging services among physicians

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Background: In 1996, the Health Insurance Portability and Accountability Act (HIPAA) was enacted to protect patient information. There are currently limited HIPAA-compliant messaging applications being used by Poison Control Centers (PCC).(1) We hypothesized that a PCC healthcare secure application messaging service could be useful for clinical providers and assessed the acceptability of such an application if it were to exist.
Methods: We surveyed resident and fellow physicians that completed a PCC-based medical toxicology rotation from October 2020-May 2021. Survey questions included demographic information, current use of HIPAA-compliant messaging systems in clinical practice, and acceptability of a PCC secure application messaging service. The software used was SurveyGizmo. IRB exemption was obtained from our institution prior to the survey and the survey was voluntary. Data are presented as descriptive only.
Results: 79 out of 198 surveyed physicians responded. We found that most respondents were in their second and third year of residency (23% and 34% respectively). Participants were from the United States, representing 4 different states, and several (6%) were from Canada. 67% of respondents primarily specialized in emergency medicine (56/79). We found that 18% (14/79) of participants noted that "time required to contact the PCC" was a reason why they did not always contact a PCC to report a poisoning case. Of the respondents, 68% (54/79) were already routinely using a HIPAA-compliant messaging application to request specialist consultation while working clinically at their own institutions. 39% (31/79) responded for patients they wanted to report only and not seek assistance in their medical management, a HIPAA-compliant application would "more likely" improve their interaction with a PCC and 16% (13/79) stated "somewhat more likely. Additionally, 46% (36/79) and 16% (13/79) respectively, responded that a HIPAA-compliant application would "greatly improve" or "somewhat improve" their likelihood to report cases to the PCC when additional advice was being sought . One write-in response identified, "time taken is the biggest (challenge?) - a chat-based app would be stellar and likely much easier for asynchronous communication. I call … PCC for all classic poisonings but would be more likely to report drug overdoses (which rarely require PCC consults but I do if I have time for reporting's sake)." Finally, 94% (74/79) stated that they had "no concerns" or reservations about contacting a PCC via a HIPAA-compliant application.
Conclusions: HIPAA compliant messaging applications are widely accepted and commonly being used at health care facilities but not at many PCCs.(1) Participants doing a rotation at our PCC believe that a HIPAA-compliant application would increase their likelihood to report cases that they were seeking management advice on and would increase reporting, in general. There should be widespread implementation of HIPAA-compliant applications to globally improve reporting of cases to PCCs.

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275. Pandemic poison center contacts for COVID-19 vaccines

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Objectives: We examined the time course and components of National Poison Data System COVID-19 vaccine phone contacts (COVID-vax-contacts) and the number of vaccine doses administered (Vaccinations) by manufacturer, by state, and by week. We wished to determine the relationship of COVID-vax-contacts by type: information calls (Info) or reports of exposure (Exposure) to Vaccinations and the change over time (COT-profile) by Health and Human Services (HHS) multistate region.
Methods: We examined all COVID-vax-contacts by type from NPDS and Vaccinations data from COVID Act Now for the period 1-Nov-2020 through 15-May-2021 by manufacturer (vaccine), by day, week, and by region. We examined clinical effects reported from Exposures by vaccine type and age group. Poison center contacts via dedicated COVID-19 hotlines were not distinguished from other contacts.
Results: As of 5/12/2021 US residents received 264.7 million vaccine doses. Poison centers reported 188,914 COVID-vax-contacts including 168,043 for a single substance from 11/01/2021 through 05/15/2021. Most (59.1%) were for Medical Information, 35.9% Drug Information, and 3.60% for Exposures. Contacts per week peaked at 17,184 during the week ending 1/13/2021. Figure 1 shows the COT-profile of COVID-vax-contacts and Vaccinations. Amongst the individual HHS regions, single substance contacts ranged from 92 to 67,640 and Exposures from 27 to 4,186. Figure 2 shows COT-profile of COVID-vax-contacts and Vaccinations by HHS region normalized to population of 18 y/o and older. Table 1 shows the percent of Exposures reporting a Clinical Effect by Vaccine for Clinical Effects reported in >10% of Exposures and Anaphylactoid reactions (reported for 2 patients receiving Pfizer and 6 patients receiving Moderna vaccine).
Conclusions: Change over time profiles show the poison center inquiries peaked early in the vaccination process and declined over the last 5 months with an increase associated with the pause in Janssen vaccine distribution. Vaccinations have been well distributed across the HHS regions. The clinical effects reported from the Exposures are consistent with the adverse events reported in the manufacturers' fact sheets. Poison centers are a trusted data source who provide information and case management 24/7. The large number of COVID-vax-contacts and availability of number of people receiving vaccine provides a unique opportunity to examine the public health impact of poison centers during a pandemic.

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276. Increasing poison center involvement in critically-ill, non-toxicological fatalities

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Background: A previous study examining fatalities managed by our regional poison center (RPC) revealed that we have been consulted on an increasing number of patients who are severely ill from likely non-toxicological etiologies. In fact, between 2009-2019 our RPC experienced a 27% increase in non-tox related fatalities, while total exposures decreased 13% and tox-related fatalities decreased 9%. The aim of this study is to characterize the trends and etiologies of the non-tox related fatalities that our RPC managed over this time period.
Methods: The password protected National Poison Data System (NPDS) website (https://www.npds.us/Logon) was retrospectively queried for fatalities our RPC submitted from 2009-2019. Cases included were those with relative contribution to fatality (RCF)

codes 4-6 (probably not responsible, clearly not responsible, and unknown, respectively). Etiologies and scenarios surrounding these cases were categorized and described. Descriptive statistics were used to report trends.

Results: Over the 11-year study period, the majority of fatalities (140 or 60%) were RCF 6, or unknown. Forty-one cases (18%) were RCF 4 (unlikely responsible). Fatalities where a toxicologic etiology was deemed clearly not responsible (RCF 5) increased significantly over the study period. While there were only 3 such cases between 2009-2011, in 2019 there were 19 cases, yielding a 533% increase in this category.

Among cases where a cause of death was confirmed or strongly suspected, sepsis was the most common, occuring in 35 cases (15.0%). The next most common etiologies were gastrointestinal bleeds (11 cases, 4.7%), intracranial hemorrhages (10 cases, 4.3%), and pneumonia/ARDS (10 cases, 4.3%).

Fatalities where no toxicologic exposure was suggested by the history increased 375% over the study period (4 in 2009 vs 19 in 2019). These consults were most often generated because providers had very limited history and circumstances suggested a possible ingestion among many other possibilities, such as a previously healthy patient found down, or a patient with an unexplained metabolic acidosis.

Conclusions: Our RPC has managed an increasing number of critically ill patients where toxicologic etiology is neither initially suspected, nor ultimately the presumed cause of death. While the reason for this is unclear, it may be indicative of evolving attitudes of health care providers in how they utilize the poison center, where they see the RPC as a resource in investigating a complicated, critically ill patient where toxicology is only one of many possibilities. Further investigation could determine which type of health care facilities tend to generate these consults.

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277. Critical access toxicology: rural and critical access hospital poison center utilization in Colorado

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Background: Colorado has 32 designated critical access-designated hospitals (CAH), which serve cities with populations ranging from 591 to 16,532 people. There is a paucity of data evaluating the usage of Poison Control Centers (PCC) in Rural and CAH.

Methods: This is a retrospective review of cases called into the Rocky Mountain Poison Control Center (RMPCC) from Colorado CAH from 2015 to 2020. CAH were identified as designated by the Colorado Hospital Association and matched with National Poison Data System (NPDS) call zip code origination. Descriptive statistical analysis was performed for age, gender, product type, exposure effect, treatment and disposition. Categorization of exposure clinical effect was based on designation at the time of the call.

Results: Of 6,996 total RMPCC calls received in the 5 years study period, 538 (7.7%) unique cases originated from Colorado CAH. Ages ranged from 1-87 years (median 27 years). Female patients made up 48.3% of cases (50% males, 1.7% unknown). Clinical effects were observed in 376 (70%) cases, which were classified as follows: minor 283 (75.2%), moderate 84 (22.3%), and major 8 (2.1%). There was one death (0.2%). Of all calls, "no effect" was observed in 119 (22.1%) and "unrelated effect" in 24 (4.5%). Nineteen cases (3.5%) were unable to be followed. Of the 987 reported agents of exposure, the majority of calls were related to "other non-drug substances" or "miscellaneous unknown drugs" making up 11% (112) and 10.7% (106) of cases, respectively. Of known drugs, acetaminophen made up 7% (74) of calls.

In the 376 symptomatic exposure cases, the treatments that were recommended and/or performed included the following (n, %): dilution/irrigation (126, 33.5%), benzodiazepines (38, 10.1%), n-acetylcysteine (19, 5%), alkalization (12, 3.1%), naloxone (4, 1%), and fomepizole (2, 0.5%). Intubation and vasopressors were required in 7 (1.8%) and 3 (0.7%) cases, respectively. There was one case each that required antivenom and hemodialysis.

Discussion: Of the 538 unique cases, 38 (7%) patients were admitted to a critical care unit. Of those patients, 14 (36.8%) had minor effect, 14 (36.8%) moderate effect, and 5 (13.1%) had major effects. One patient died in the ER from "other non-drug substances." The NPDS does not allow for characterization of patients transferred from a CAH to a non-CAH higher level-of-care for ongoing management.

Conclusions: Between 2015 and 2020, Critical Access Hospitals in Colorado made up 7.7% of all Colorado-based calls to the RMPCC. Most of the reported cases had some degree of clinical effect that resulted in treatment recommendation. Aside from benzodiazepines and n-acetylcysteine, specific antidote administration was rare. Only one death was reported in the 5-year period observed. It is important to note that NPDS data is limited by calls received and may not fully reflect all cases presenting to CAHs. Given the limited resources of CAH, further retrospective case-specific descriptive statistics and/or prospective data collection may be of use in understanding the logistical challenges of treating toxicologic exposures in critical access hospitals.

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278. Unintentional buspirone ingestions in children <6 years old

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Objectives: Buspirone is an azaspirodecandione derivative used as an anxiolytic in adults. There are no studies evaluating unintentional pediatric ingestion. We have evaluated unintentional ingestion of buspirone ingestion in children <6 years reported to US poison Centers.

Methods: Retrospective analysis of cases reported to the National Poison Data System (NPDS) of unintentional single-substance ingestion of buspirone in children <6 years between the years 2000 to 2019. Analysis involved descriptive statistics of demographics and temporal trends.

Results: There were 4109 children with ingestions, of which 2148 (52%) were male. There was a mean of 205 cases per year (range 128-333) with a peak in 2017 and a nadir in 2006. Sixty-two percent (n= 2538) children were managed onsite (home) and 37% (n = 1520) were seen in a HCF. 826 children were already in a HCF and 694 children were referred to HCF. There were 1954 children with no effect (48%), 438 minor effect (11%), 1535 not followed to outcome (37%) and 141 confirmed non-exposure or unrelated effect (3%). There were 41 moderate effect, no major effect and no fatalities. The primary effects were neurological and GI: CNS (mild)/drowsiness (n = 345), vomiting (n = 64), Ataxia (n = 28), agitation

(n = 17), other miscellaneous (n = 17), dizziness (n = 9), nausea (n = 9), tachycardia (n = 7), headache (n = 4) and CNS (moderate) (n = 4). Over the 20 years there were 2 children with seizures. One seizure occurred in a 2 month old and the second child with seizure was an 11 month old, both with unknown amount ingested. There were no cases of respiratory depression.
Discussion/Conclusion: There is limited data on overdose of buspirone in adults and no studies on ingestion in children. This has made triage decisions for unintentional ingestion in children difficult. Our results of 20 years of cases suggests that unintentional buspirone ingestion in children under 6 years produces only mild clinical effects. Two rare seizures occurred in children under 12 months of age. Healthy children with unintentional ingestion of buspirone can be safely monitored at home with appropriate follow up.

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279. Acute renal failure following unintentional 2.3% diquat ingestion

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Background: Diquat is an agricultural herbicide that is widely used given its cheap manufacturing process and minimal environmental toxicity. It is a bipyridyl compound similar to paraquat and is corrosive to human mucous membranes. Diquat induces significant intracellular oxidative stress via uncontrolled free radical generation, referred to as redox cycling. In addition to multiorgan damage, diquat specifically causes acute renal failure at doses exceeding 1 gram. However unlike paraquat, diquat does not cause pulmonary fibrosis. Ingestions of more than 12 grams are considered universally fatal.
Case report: This is a single patient case report. A 63-year-old male with previously normal renal function presented to the emergency department four days after an unintentional ingestion of 8 ounces of Spectracide Weed and Grass Killer Concentrate, containing 2.3% diquat dibromide (5.4 grams of diquat). The patient mistook the substance for ginger ale. The product also contained fluazifop butyl 1.15% and dimethylamine 0.77% which are not known to cause significant human toxicity.
After a brief period of vomiting, he was initially asymptomatic but developed delayed odynophagia and dysphagia. He was unable to tolerate oral fluids and had oropharyngeal blistering. Labs demonstrated acute oliguric renal failure with a BUN of 144 mg/dL and a serum creatinine of 14.9 mg/dL associated with an anion gap metabolic acidosis. A serum diquat concentration could not be obtained. He received one week of intermittent dialysis before ultimately being discharged once able to tolerate swallowing. An endoscopy was never performed. Experimental therapies of N-acetylcysteine, ascorbic acid, and corticosteroids were not recommended due to delay in presentation. His present dialysis requirements are unknown.
Discussion: Diquat toxicity is rarely reported and most cases involve ingestions of high concentrations (20%). Diquat herbicides available to consumers are typically lower in concentration (0.1-2%). To our knowledge, this is one of two reported cases of diquat toxicity associated with acute renal injury from a low concentration product. In addition, this case is unique in that acute renal failure requiring dialysis occurred; the other reported case from 1999 never required dialysis.
Therapeutic options for diquat toxicity are limited beyond basic supportive care and decontamination. Dialysis has unclear efficacy but has theoretical benefit if performed within hours following ingestion. N-acetylcysteine and ascorbic acid have been proposed for their antioxidant effects and are often recommended due to their relatively benign safety profile. Studies on corticosteroids and deferoxamine show unclear benefit. Massive ingestion continues to be catastrophic and universally fatal.
Conclusion: We report a case of a low concentration diquat ingestion leading to oropharyngeal mucous membrane injury and acute renal failure requiring dialysis.

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280. Use of activated charcoal for decontamination in 0 to 5-year-olds presenting to the emergency department with poisoning

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Background: In our Canadian Province, 31% of calls to the Poison Center in 2019 were for children aged 0 to 5 years old. The first decontaminating agent advised in those cases was oral activated charcoal (AC). However, insufficient data documents or supports the use of AC in pediatric poisoning. Our main objective was to measure the incidence of AC use and identify its determinants in a population intoxicated by a carbo-adsorbable substance. A secondary goal was to compare patient outcomes according to AC administration.
Methods: We conducted a multicenter retrospective cohort study using retrospective data collected from health records of hospitalizations between 2013 and 2016 at three health care facilities in our Canadian Province. We included all poisoned children aged 0 to 5 years old if managed in the emergency department (ED) within 12 hours of ingestion of a potentially toxic dose of an AC-adsorbable substance. Children treated by AC before arrival at the ED were excluded. We calculated the cumulative incidence of AC administration in our study population. For our first objective, we used logistic regression models to identify the main determinants of AC use among baseline characteristics of the patients, including data on their intoxication and their preexisting health status. For our secondary objective, children decontaminated or not by AC were compared to assess different outcomes: progression of toxicity (measured by the 12-hour delta Poisoning Severity Score), intensive care unit (ICU) admission, hospital length of stay $\geq$12 hours, and the need for follow-up after discharge.
Results: Of the 261 subjects eligible for this study, 11 (4%) were excluded because of CA administration before arrival at the ED. Of the 250 remaining children, 60 (24%) were treated by oral AC. Among baseline characteristics collected on arrival in the ED, the delay between intoxication and ED presentation was the strongest determinant of AC use ($p < 0.0001$). Children hospitalized within 90 minutes after poisoning were about nine times more likely to be treated by AC than children who arrived later at the ED (OR =9.4, 95% confidence interval (CI) 4.4-20.1). The use of prescription medication was associated with a diminution of AC prescription (OR =0.38, 95% CI 0.15-0.95). For our secondary objective, preliminary descriptive analyses showed no statistical differences between children for ICU admission or discharge status according to decontamination status (p-value >0.05). Children treated with AC tended to stay longer in the hospital than their counterparts, but the difference was not statistically

significant. In contrast, an increase in the 12-hour delta PSS was significantly associated with the absence of AC decontamination.
Conclusions: About one in four 0 to 5-year-olds intoxicated by a carbo-adsorbable substance was treated by AC in the ED in our study population. Following the recommendations for AC use, the time between intoxication and hospitalization seems to be decisive in the administration of AC. Comparing the clinical outcomes of poisoned children according to decontamination status should allow us to discuss the pros and cons of using AC in this young population.

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281. Predictors of severe outcome following opioid overdose in children: a case-control study of a prospective toxicology surveillance registry

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Objective: To explore predictors of severe outcomes (i.e., intensive care admission [ICU] or death) in children who present to hospital with an opioid overdose.
Methods: In this multi-center prospective cohort study of all pediatric patients (0–18 years) presenting to one of 38 sites affiliated with the American College of Medical Toxicology's Toxicology Investigators Consortium (ToxIC), and who received a bedside consultation by the respective medical toxicology service, between August 2017 and June 2020. We collected relevant demographic, exposure, clinical course, disposition, management, and outcome data. Employing a multivariable logistic regression analysis, we conducted a case-control study to explore predictors of severe outcomes. Cases were children who had severe outcome; controls were those without a severe outcome.
Results: Of 165 (87 females, 52.7%) eligible children, 89 (53.9%; "cases") were admitted to ICU or died during hospitalization from hypoxic-ischemic brain injury secondary to respiratory depression (i.e., severe outcomes); 77 (46.1%; "controls") did not experience a severe outcome. Seventy-five children (45.5%) were intoxicated by opioids prescribed to family members. Exposure to fentanyl (adjusted OR =3.7, 95% CI 1.1 to 11.9; $P = 0.02$) and age ≥10 years (adjusted OR 2.0, 95% CI 1.0 to 3.7, $P = 0.03$) were independent predictors of severe outcomes. Infants up to 12 months of age were more likely than older children to present to the emergency department with severe respiratory depression- bradypnea (86.4% vs. 46.2%, $P < 0.01$), documented hypoxia (59.1% vs. 23.1%, $P < 0.01$), and tended to present with lower Glasgow Coma Scale (GCS) score (GCS ≤8; 51.4% vs. 32.8%, $P = 0.057$); Infants were more likely to receive naloxone (72.7% vs. 49.7%, $P = 0.03$).
Conclusions: In children who present to hospital with an opioid overdose, exposure to fentanyl compared with other opioids is associated with an almost four-fold increased risk of ICU admission or death, and age ≥10 years with more than double the risk compared with younger children. Intoxicated infants present sicker and are more likely to receive antidotal therapy. Prevention efforts should target those risk factors to mitigate poor outcomes of opioid overdose in children.

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282. Changes in poisonings treated at emergency departments during the COVID-19 pandemic

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Background: Since the start of the COVID-19 pandemic in 2020, United States (US) emergency department (ED) visits not related to COVID-19 have declined, particularly for certain populations and certain types of illness or injury. A portion of poisonings are managed in EDs. The objective of this study was to identify poisonings treated at US EDs in 2020 and compare them to 2019.
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. (According to the NEISS manual, product-related includes all poisonings to children under 5 years of age. Only certain poisonings among older individuals are included.) 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 injuries reported to the NEISS during 2019 and 2020 where the diagnosis code for poisoning (68) was documented in the Diagnosis or Diagnosis_2 data fields. The Diagnosis_2 field was only added to the NEISS database in 2019, so previous years could not be included in the study. The estimated number of poisonings reported during 2020 was compared to the estimated number reported during 2019.
Results: An estimated 252,492 poisonings were treated at EDs during 2020, a decrease of 2.9% from 2019 (n= 260,147). [In comparison, an estimated 10,994,077 total product-related injuries were treated at EDs during 2020, a decrease of 18.3% from 2019 (n = 13,464,372).] The estimated number of poisoning patients in 2020 age 0-4 years decreased 10.3% (66,745 in 2019,

59,837 in 2020), 5-12 years decreased 12.7% (3,373 in 2019, 2,943 in 2020), 13-19 years decreased 20.1% (9,060 in 2019, 7,238 in 2020), and 20 years or older increased 0.8% (180,935 in 2019, 182,340 in 2020). The estimated number of poisonings in 2020 that occurred at home decreased 0.3% (151,674 in 2019, 151,172 in 2020), at other public property or place of recreation or sports decreased 11.5% (35,820 in 2019, 31,700 in 2020), on a street or highway increased 6.6% (9,088 in 2019, 9,686 in 2020), and at school decreased 62.5% (2,207 in 2019, 828 in 2020). The estimated number of poisoning patients in 2020 who were treated and released or examined and released without treatment decreased 5.7% (190,111 in 2019, 179,247 in 2020) while those who were treated and admitted for hospitalization (within same facility), treated and transferred to another hospital, held for observation (includes admitted for observation), or died increased 7.3% (61,545 in 2019, 66,051 in 2020).
Conclusion: While all product-related injuries treated at EDs declined by 18.3% in 2020, the number of poisonings decreased only by 2.9%. Poisonings involving children declined while those involving adults remained level. Poisonings that occurred at most locations decreased with the greatest percent decline observed for poisonings that occurred at school. While the number of poisoning patients who were treated and released declined in 2020, the number of patients with more serious management (e.g., hospitalized) increased.

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283. Impact of the TikTok™ Benadryl® challenge on frequency and severity of adolescent diphenhydramine ingestions

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Background/Objectives: Diphenhydramine, a first-generation antihistamine, is used to treat allergic reactions, taken in self-harm attempts, and taken recreationally to incite euphoria. In May 2020, the first cases of diphenhydramine overdose directly related to a video posted on social media platform TikTok™ were reported. This video challenged viewers to take a large amount of diphenhydramine and document their experience. At this time, the impact of social media platform challenges on frequency of ingestions in adolescents reported to United States (US) poison centers is unknown. The primary objective of this study was to determine if the frequency of adolescent diphenhydramine ingestions in the US, as reported to National Poison Centers, changed after the TikTok™ Benadryl Challenge was introduced. The secondary objective was to determine if a change in severity, defined by symptoms, treatments delivered, and overall medical outcome, also occurred.
Methods: This was a national, multi-center, retrospective study of adolescent patient cases with a primary ingestion of diphenhydramine reported to any poison control center in the US. Deidentified data from the National Poison Data System was obtained from January 2010 to December 2020. Data from January 1, 2010 – December 31, 2019 was used to determine exposure trends prior to the TikTok™ challenge. Data from January 1, 2019 – December 31, 2020 was then compared to evaluate if an acute increase in exposures or severity occurred during the time around the challenge. All patients aged 10-19 years old were included. Intravenous diphenhydramine and confirmed non-exposures were excluded. The primary outcome was incidence of oral diphenhydramine ingestions in patients 10-19 years old. Secondary outcomes included incidence of agitation, seizures or seizure-like activity, prolonged QTC (QTC >500), prolonged QRS (QRS >120), arrhythmias, benzodiazepine or physostigmine administration, and medical outcome. This study was deemed to be non-human-subjects research by the Institutional Review Board.
Results: A total of 46,121 diphenhydramine cases over the 10-year period were reviewed. Incidence increased steadily from 1,949 cases in 2010 to 5,247 cases in 2019. No acute increase in incidence of diphenhydramine ingestions was noted between 2019 and 2020 (N = 5,247 versus 5,495) or between early 2020 (January – May; N = 2299) and late 2020 (June – December; N = 3196). Of the secondary outcomes, only a significant difference in incidence of agitation, and subsequently benzodiazepine administration, was noted ($p = 0.011$ and $p = 0.0011$, respectively) between 2019 and 2020. Significantly fewer patients were followed by poison centers in 2019 than 2020, due to exposures being deemed as either nontoxic or having minimal clinical effect ($p = 0.027$ and $p = 0.014$, respectively). More patients were also determined to have a moderate clinical effect from ingestion in the 2020 cohort ($p = 0.0019$). Interestingly, however, despite no difference in those with a severe effect, more deaths were reported in 2019 than 2020 (N = 8 versus 1; $p = 0.016$).
Conclusions: Frequency of adolescent diphenhydramine cases did not increase significantly following the TikTok™ Benadryl challenge. However, cases were more likely to be followed by poison centers and deemed moderate in severity, with more patients requiring benzodiazepine administration compared to previous years.

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284. Hemolysis from subcutaneous deoxycholic acid injections

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Background: Deoxycholic acid (DCA) is an endogenous bile acid that emulsifies fat within the lower gastrointestinal tract to improve intestinal absorption. This emulsification property allows DCA to dissolve adipocyte cell membranes. While currently only FDA-approved for the reduction of submental fat, DCA has been evaluated for reduction of fat in other areas. This formulation contains DCA 10 mg/mL with benzyl alcohol preservative, in 2mL vials. DCA can also be obtained by interested individuals from unregulated sources to aid in targeted adipose tissue loss. Unsupervised use of unregulated DCA possesses significant health risks due to potential contamination of the product, inappropriate dosing, and inappropriate use. We describe a case of hemolysis following excessive subcutaneous injections of DCA into the abdominal tissue, in a patient using unregulated DCA.
Case report: A 28-year-old male presented to the emergency department with gross hematuria, tinnitus, and abdominal pain. He reported purchasing DCA and benzyl alcohol online, mixing 10 grams in 500mL, and injecting the mixture subcutaneously into his abdomen to induce lipolysis. The night prior the patient reported injecting 50mL of the mixture, five times more than he was previously administering, in five different areas of the abdomen. Thirty minutes later he developed maroon-colored urine. Physical exam revealed indurated abdominal tissue, with palpable hematomas and tenderness. Urinalysis showed proteinuria (protein 100mg/dL), with a large amount of blood but no red blood cells detected. Total bilirubin was elevated at 1.5 mg/dL,

alanine aminotransferase was 36 units/L and aspartate aminotransferase was 55 units/L. Lactate dehydrogenase (LDH) was elevated at 656 units/L and haptoglobin was undetectable(<8mg/dL). The patient was admitted and hematology was consulted. A peripheral blood smear was normal and direct antiglobulin testing was negative for antibodies against red blood cells. Initial hemoglobin and hematocrit were 16.7 g/dL and 45.3%, and remained stable throughout hospitalization. The patient was discharged after two days without complication and instructed to cease further injections of the DCA product.

Discussion: The safety of DCA injections has previously been studied and supported in multiple Phase III trials, case reports and case series. Reports following FDA approval also reinforced the relative safety of these injections when managed by a medical professional. Typical maximum dosing for the FDA-approved indication of submental fullness is a total of 10mL. Adverse events include mild to moderate injection site reactions, including pain, swelling, numbness, bruising and induration, dysphagia, and marginal mandibular nerve paresis. However, unsupervised use of non-FDA approved formulations of DCA come with additional unknown risks to patients. Benzyl alcohol, typically associated with neurologic effects with intrathecal administration, has also been implicated in case reports and laboratory studies of hemolysis and may have contributed to this case. Our patient presented with hemolysis from self-injection of a 5-fold overdose of DCA.

Conclusion: Unsupervised use of unregulated DCA for aesthetic benefit can lead to hemolysis after subcutaneous injection when used without medical supervision. Providers should be aware of the potential for medically unsupervised use of DCA and the potential risks associated with it.

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285. Methanol in hand sanitizers: a poison center pediatric nightmare

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Background: In July 2020 the U.S. Food and Drug Administration (FDA) discovered serious safety concerns with numerous hand sanitizers contaminated with methanol. Methanol is a toxic alcohol that is not an accepted ingredient in hand sanitizers as it may cause acidosis, blindness, and death when ingested. As little as one teaspoonful of methanol 70% in a small toddler could cause serious harm. This posed a difficult dilemma for many poison centers when it came to triaging inadvertent pediatric ingestions, especially in light of an increase in exposure calls due to COVID-19 and a growing list of methanol-contaminated hand sanitizer products. For these reasons, a regional poison center (PC) began referring children sent to emergency department (ED) for any hand sanitizer exposure with an ingestion greater than a taste or unwitnessed ingestion unless product safety information was obtained from the hand sanitizer manufacturer or the product was purchased prior to the COVID pandemic. The FDA list of unsafe hand sanitizers was also utilized.

Methods: This is a retrospective evaluation of hand sanitizer ingestions in pediatric patients <6 years old reported to a regional PC from January 1 2020 to March 1 2021. We performed a search of unintentional ingestions using the AAPCC generic codes for hand sanitizers (200613, 200614, 200615, 200616). We reviewed the management sites of these cases (managed on site or already in/enroute or referred to health care facility HCF). We compared the level of HCF care (treated/evaluated and released from the emergency department, admitted to non-critical floor or critical care unit, refused referral, or lost to follow-up) and the medical outcomes of these patients. Cases from 2018 and 2019 were reviewed as a pre-COVID comparison.

Results: There were 634 cases identified in 2020-2021 (COVID years); of these cases, 12.5% were referred in to the healthcare facilities (HCF) by the PC in comparison to 0.8% in 2018-2019. Of those 109 cases managed in HCF during COVID, 65% were evaluated/treated and released from the emergency department (ED), 18% admitted to noncritical care, 0.9% admitted to critical care, and 15.6% were lost to follow up; in comparison to 2018-2019, only 21 cases were managed in HCF and were all treated and released from the ED. No serious outcomes were observed in the patients managed in HCF .

Conclusion: There was a substantial increase in the number of pediatric hand sanitizer exposures managed in a HCF during the COVID-19 pandemic years. Despite the increase in exposure calls, no serious outcomes were observed. Poison centers should continue to be vigilant in the management of pediatric hand sanitizer ingestion and utilize resources such as the FDA unsafe list of hand sanitizers or reach out to manufacturers for product safety information.

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286. Equine pergolide exposure in toddler resulting in hospitalization

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Background: Pergolide is a synthetic ergoline dopamine agonist used in equine veterinary medicine to treat pituitary pars intermedia hyperplasia or equine Cushing's Syndrome. It is a D2 (and D1) agonist with actions similar to bromocriptine for use as an antiparkinson agent. Pergolide was withdrawn from human use in 2007 by the FDA due to risk of serious valvular heart disease, but remains available in the veterinary market. We present a case of pediatric exposure to pergolide.

Case report: A previously healthy 3-year-old girl presented to the emergency department with acute delirium, mydriasis, tachycardia, diaphoresis and episodes of emesis after playing outdoors behind her residence near a horse stable. No witnessed ingestions were known at that time. The child was admitted to the hospital overnight for observation, gradually clearing her symptoms over approximately 12 hours after presentation. On the following day the patient's mother was informed by one of their horse boarders that an 8 mg tablet of Prascend® (pergolide, available from Boehringer Ingelheim for equine use) was lost near the stable where the child was playing on the day she became ill .

Discussion: Toddler ingestion of veterinary products continues to occur on occasion in the United States. We were unable to locate any previous reports of pediatric overdose or toxicity from pergolide in the literature. Poisoning in humans has caused GI disturbances, hypotension, dyskinesia, diaphoresis, somnolence, and agitation; and in adults doses from 7 to 60 mg have caused palpitations, hypotension, ventricular extrasystoles and agitation. Thus a single veterinary 8 mg tablet represents a significant risk to a child if not kept out of their reach. The child's symptoms cleared much sooner than perglolide's half-life of 27 hours might suggest.

Conclusion: Pergolide toxicity should be part of the differential when a child presents with altered mental status, diaphoresis and GI disturbance and may have been near where horses are kept. A single equine tablet represents a significant risk to children in the case of an exploratory ingestion.

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287. Implementation and evaluation of Project ECHO© for Specialists in Poison Information (SPIs)

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Background: It is established that adult learners learn differently: they understand why something is important; have the freedom to learn their own way, on their own time; learn via experiencing; and learn best when the environment is positive and encouraging. Project ECHO© is suitable for adult learners across all medical disciplines. The ECHO© model uses a virtual meeting platform (e.g. Zoom®) to facilitate case-based discussions (experiential learning) among participants. It focuses on the needs of the learners and provides an opportunity for collaborative shared decision-making via an "All teach, all learn" approach. To our knowledge, Project ECHO© has not been utilized for Specialists in Poison Information (SPI) education. This pilot study aimed to look at the feasibility of implementing Project ECHO© among a group of SPIs from different poison centers and evaluate the impact on self-reported clinical knowledge and perceived self-efficacy in managing acutely poisoned patients.
Methods: Four poison centers participated in this project (CT, MA/RI, Northern NE (Maine), Upstate NY). SPIs were encouraged to attend via repeat emails and flyers. The ECHO© sessions occurred monthly starting January 2021. Each session included a short (15-20 minute) didactic presentation followed by a 75-minute case-based discussion. A 13-question anonymous survey was sent to all 68 participating SPIs after five ECHO© sessions.
Results: A total of five monthly ECHO© occurred with a total of 115 attendees (average 23 attendees per session). Each session was 1.5 hours. SPIs progressively increased their active participation over time.
Twelve SPIs completed the survey: 83.33% of respondents agreed or strongly agreed that participation in ECHO® aided in the development of clinical knowledge in assessing poisoned patients; 100% of respondents agreed or strongly agreed that they have acquired new knowledge because of Project ECHO®; 83% of respondents agreed or strongly agreed that collaboration with SPIs from other poison centers was beneficial to their practice.
Conclusion: This is the first successful implementation of Project ECHO© for SPIs. In all, the majority of SPIs who participated felt they gained new knowledge and increased self-efficacy. The Project ECHO© model complements other more traditional lecture-based teaching models; it offers yet another effective way to learn and provides a forum in which SPIs can meet and collaborate with their peers from other poison centers.

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288. Massive aripiprazole overdose in a toddler

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Background: Aripiprazole is an atypical antipsychotic with unique receptor binding properties that, when taken in therapeutic doses, has a favorable safety profile compared to other antipsychotics. Extrapyramidal symptoms and QT prolongation are rarely observed in therapeutic use. In pediatric overdose, prolonged lethargy is commonly described, as well as occasional extrapyramidal symptoms. Cardiovascular effects in pediatric patients appear to be rare, without reported arrhythmia or cardiac death.
Case report: A 21-month-old male presented to the emergency department with lethargy in the setting of an unwitnessed ingestion of 26 aripiprazole 2 mg tablets, which were prescribed for another household member, approximately 6 hours prior to presentation. The patient's vital signs were: heart rate, 151/min; blood pressure, 144/92 mmHg; respiratory rate, 28/min; rectal temperature, 36.1°C; room air oxygen saturation, 98%; weight, 12.2 kilograms; venous blood glucose, 147 mg/dL. On initial evaluation, the child was lethargic but arousable to tactile stimuli, with decreased bowel sounds. The remainder of the physical exam was unremarkable, specifically without rigidity, tremor, clonus, spasticity, or urinary retention. Initial laboratory analysis, including venous blood gas, complete blood count, electrolytes, hepatic panel, and creatine kinase, were normal. Serum acetaminophen, salicylate, and ethanol concentrations were undetectable. The initial electrocardiogram showed sinus tachycardia, with QRS and QTc (corrected with Rautaharju method) intervals of 70 and 240ms, respectively. ST depressions were present in the anteroseptal leads, although further cardiac workup with serial cardiac enzymes and echocardiography was unremarkable. He was admitted to the PICU, where he experienced approximately 36 hours of lethargy, followed by 24-36 hours of irritability associated with upper extremity spasms and tremors, which resolved without intervention. Hyperreflexia was present in the bilateral patellar tendons, although no clonus was elicited. Aripiprazole and dehydro-aripiprazole serum concentrations measured 46 hours after reported time of exposure were 266.5 ng/mL and 138.6 ng/mL, respectively (therapeutic concentration of aripiprazole and metabolite are not well established). Concurrent medical workup was unremarkable, and the patient returned to neurologic baseline and was discharged approximately 72 hours after exposure.
Discussion: Neurologic toxicity, particularly lethargy, has been reported as a defining feature in case reports of pediatric aripiprazole overdose. In this patient, one day of sedation was followed by 36 hours of tremors, spasms, and hyperreflexia. While cardiac toxicity, particularly QT prolongation, is a known side effect of many antipsychotics, our case report, to our knowledge is the first to describe transient ST segment depressions in a patient following aripiprazole overdose, though no prior ECG was available for comparison and the clinical implications remain uncertain as further cardiac workup was unremarkable.
Conclusion: Pediatric providers should be aware of the potential for several days of neurologic effects of aripiprazole overdoses in children. Management of pediatric aripiprazole overdose is supportive. Families with children should be counseled on the potentially severe effects of unintentional aripiprazole overdose at the time of prescription to enact safe storage to mitigate the possibility of unintentional ingestion.

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289. A fatal overdose of colchicine in an adolescent

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Background: Colchicine is a potent inhibitor of microtubules that interferes with cellular mitosis and intracellular transport mechanisms. Management of patients with colchicine overdose is extremely challenging to clinicians because of colchicine's narrow therapeutic index and lack of an effective antidote. Although typically prescribed to adults for gout, pericarditis, or COVID-19, colchicine is occasionally ingested by children in overdose and results in significant morbidity or mortality. We describe an adolescent who presented to the emergency department following an acute overdose of colchicine with a persistently detectable blood colchicine concentrations for at least 7 days following the ingestion.
Case report: An adolescent with no known significant past medical history presented to the emergency department 24 hours after an intentional overdose of an unknown amount of colchicine. The patient had profound nausea, vomiting, abdominal pain, and diarrhea. The initial vital signs were: BP, 102/71 mm Hg; HR,121 beats/minute; Respiratory Rate, 14 breaths/minute; Temperature, 97.9°F (36.6 C), O2 Saturation, 96% (room air). Laboratory tests drawn at 24 hours post-ingestion (hospital day 1) were notable for a white blood cell (WBC) count of 27,000/mm3 with negative salicylate and acetaminophen concentrations. Around 30 hours post-ingestion, the patient developed acute hypoxic respiratory failure, altered mental status, and cardiogenic shock. He required endotracheal intubation and multiple vasopressors for hemodynamic support. After nasogastric tube placement, 50g of activated charcoal was administered. An echocardiogram demonstrated global decreased systolic function, with an ejection fraction of 38%. Around 34 hours post-ingestion, the patient experienced a bradycardic cardiac arrest followed by return of spontaneous circulation and was initiated on both extracorporeal membrane oxygenation (ECMO) and continuous renal replacement therapy (CRRT). The WBC count dropped progressively to a nadir of 0.6/mm3 on hospital day 8; serum troponin I rose to a peak of 3.71ng/mL on hospital day 8. Exchange transfusion was attempted on hospital day 6 but was discontinued after the patient developed hypotension. Despite the above interventions, the patient died on hospital day 8. The patient's blood colchicine concentration on hospital day 1 (~30 hours post ingestion) was 12ng/mL. Subsequent values sent on hospital days 5 and 7 were 11ng/mL, and 9.5ng/mL, respectively.
Discussion: Colchicine remains one of the most feared drugs in overdose because of its severe toxicity and lack of an effective antidote. Despite interventions such as activated charcoal, ECMO, and exchange transfusion, colchicine remains highly lethal. Other therapies for colchicine toxicity are virtually nonexistent. Colchicine-specific antibodies are not commercially available but represent the only other potential therapy that could limit such devastating toxicity.
Conclusion: Significant colchicine overdoses are often catastrophic and lead to significant morbidity and mortality. Because of its widespread use to treat various inflammatory disorders, we believe that pediatric colchicine exposures could increase in frequency. Although rare, pediatric providers should be aware of the significant risks associated with acute colchicine overdose.

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290. Evaluating resources utilized by poison centers for pediatric guanfacine exposures

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Background: Guanfacine prescriptions for pediatric attention-deficit/hyperactivity disorder have steadily increased, leading to a rise in accidental guanfacine exposures in the 0-12 year age group reported to poison centers. Due to a prior lack of FDA approval for young children, numerous medical resources recommend referring all pediatric guanfacine exposures into the emergency department (ED) for evaluation and monitoring. However, data reveals that the majority of pediatric exposures have mild to no adverse effects. Children in this age group are often started on guanfacine therapy at home without issue. Due to the changing landscape of pediatric guanfacine use, we sought to evaluate the resources used by each of the U.S. poison centers and to determine whether current guanfacine referral guidelines are consistent.
Methods: Each of the 52 individually-funded U.S. poison centers were contacted via email, provided a brief description of the project, and asked the following questions.
Does your poison center have a center-specific written referral guideline for pediatric guanfacine exposures?
If you do have one, can you send it by replying to this email and attach the guidelines?
If you do not have one, what are your specialists in poison information (SPIs) utilizing as a source to determine the need for referral following a pediatric guanfacine exposure (e.g., Micromedex, Lexicomp, other)?
Poison centers could reply with more than one answer if their staff utilized multiple resources. All responses have been kept anonymous with results reported only in aggregate form. This project was reviewed by the Institutional Review Board and determined to be exempt.
Results: Of the 52 U.S. poison centers, 37 responded with information about their pediatric guanfacine referral guidelines. The majority (89%) endorsed using either Micromedex or webPOISONCONTROL. These resources vary in recommendations; Micromedex refers in all pediatric exposures except for double doses in children prescribed guanfacine over age 6 years, and webPOISONCONTROL refers children based on age and dose (in mg) of guanfacine ingested. Three centers reported using Lexicomp or the Lange handbook. Twenty-five centers (67%) use a single resource or guideline. Twelve centers (32%) endorsed having a center-specific guideline. The guidelines used by centers do not provide consistent recommendations, and vary from referring all children exposed into the ED, referring in based on symptoms regardless of amount ingested, or referring in based on amount ingested by weight.
Conclusions: This study confirmed that there is not a unified approach to the use of referral guidelines for pediatric guanfacine exposures. Additionally, there are a multitude of available resources for SPIs and toxicologists, often with varying referral recommendations. This lack of national consensus can create confusion for poison center staff, including fellows-in-training. We propose that poison centers develop a national referral guideline for pediatric guanfacine exposures to assure that a standard approach is used among all 52 poison centers. Clinical judgment on behalf of the SPIs and toxicology team is always important, but a uniform approach to guanfacine exposures can help reduce variations in recommendations and ultimately improve communication between poison centers, professionals, and the public.

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291. Implementation of an outpatient weaning program for infants with neonatal opioid withdrawal syndrome (NOWS)

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Background: Chronic opioid exposure in mothers during pregnancy is increasingly common. Whether due to prescription or recreational use, it will lead to neonatal opioid withdrawal syndrome (NOWS) in the newborn. Based on the severity of symptoms in the infant, pharmacologic treatment may be started with an opioid agonist. Typically, initial treatment occurs in a neonatal intensive care unit (NICU) and infants are often not discharged home until one or two days after the agonist is completely weaned off. This was the practice at our institution in April 2019, when, in cooperation with our NICU, an outpatient weaning program, named "EARLY OWT", was implemented. After stabilization in the NICU, infants selected to participate were discharged home with prescriptions to continue liquid morphine and followed up in clinic with nurse navigator and physician encounters. Infants who had completed weans in the NICU were also referred to the clinic for a follow-up after hospital discharge. We assess some outcomes of the program as a quality improvement project.
Methods: Records of infants seen through this program from inception through April 2021 were analyzed and descriptive statistics were compiled. NICU time savings were estimated based on the assumptions typical of the practice in our NICU: wean of 0.02 mg every two days to a final dose of 0.02 mg/kg and discharge two days after final wean.
Results: Fourteen infants were evaluated for the weaning program and ten infants were accepted. Five of the mothers were on methadone and four were on buprenorphine and each continued the medication after delivery. The remaining mother used recreational fentanyl during the pregnancy and the infant was discharged home with a foster family. An estimated 120 total NICU days (median =8; range 4 – 36 days) were saved in this program. The median number of clinic visits was 6.5 (range 3 – 28). Morphine weans were also continued to a lower dose than would otherwise have occurred in the NICU. There were no hospital readmissions or deaths during weans. The most common non-NOWS issues were oral candidiasis and poor weight gain. There was one death approximately one month after completion of a wean, reportedly from Sudden Infant Death Syndrome (SIDS). Six other infants were seen in the clinic for follow-up, either after completion of a wean, or after discharge from the nursery following an initial observation period. One infant from this latter group was readmitted to the NICU from the clinic for pharmacologic treatment and is included in the program data. There was a period of one year without patients while the program was paused for CoVID-19.
Conclusions: An outpatient NOWS program was able to facilitate early NICU discharges for infants being treated with agonist therapy, with consequent savings in NICU days. Participants successfully completed morphine weans as outpatients without any hospital readmissions or deaths. Half of the mothers participated successfully despite the demands of daily methadone dosing for themselves.

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292. Unintentional ethylene glycol ingestions in children

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Background: Toxic alcohol poisoning may result in severe acidemia, end organ dysfunction, and ultimately death. Pediatric exposures create angst not only in the patient's caretaker, but also in the clinician at the bedside and medical toxicology consultants. Previous work from our regional poison center (RPC) revealed that most pediatric unintentional methanol exposures are benign and do not require alcohol dehydrogenase (ADH) blockade or hemodialysis. The aim of this study was to quantify the frequency and severity of unintentional ethylene glycol (EG) ingestions in young children, and to characterize the measures employed in managing these patients.
Methods: All EG cases in patients less than 6 years of age reported to our RPC over a 19 year period (January 1, 2002 through December 31, 2020) were retrospectively queried. Inclusion criteria were unintentional ingestions where EG concentrations were obtained. Frequency of treatment with fomepizole, ethanol, and hemodialysis was searched. Additionally, transfer to a higher level of care was recorded.
Results: Twenty-nine cases met inclusion criteria. EG concentrations were undetectable in 25 cases (86%). Among the 4 cases with detectable concentrations (2.5, 9.9, 12, and 14.9 mg/dL) no patient was symptomatic or acidemic. None of these EG concentrations warranted treatment with ADH inhibition or hemodialysis. However, as EG concentrations were pending, fomepizole was administered in 20 cases (one case received 2 total doses) and ethanol was administered twice (one case also received fomepizole). Hemodialysis was never utilized. Over half (15) of the patients were transferred to a higher level of care.
Conclusions: Only 14% of cases in this series had detectable EG concentrations and none of them required antidotal therapy or hemodialysis. However, the majority of cases (69%) were treated with ADH inhibition and over half (52%) were transferred to institutions with pediatric intensive care units and the ability to perform hemodialysis. These measures proved to be unnecessary during the 19 year period. Unintentional EG ingestions in typical pediatric patients may warrant nothing more than repeat labs (electrolytes, pH) over time to ascertain the development or degree of toxicity.

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293. Pediatric beta-adrenergic antagonist ingestions reported to the National Poison Data System, 2000-2020

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Background/Objectives: Beta-adrenergic antagonists (BAA) are commonplace, and small quantities are described as potentially lethal when ingested by children ("one pill can kill"). We seek to describe demographics, clinical characteristics, and rate of serious outcomes amongst pediatric patients with reported BAA ingestions.

Methods: Retrospective review of United States patients <20-years-old with acute single-agent BAA ingestions presenting to a healthcare facility between January 2000 and February 2020 for whom a Poison Control Center (PCC) was consulted. Data was abstracted from the National Poison Data System (NPDS). Medical outcomes were assessed by the NPDS scale of *no effect*, *minor effect*, *moderate effect*, *major effect*, and *death*. *No effect* and *minor effect* were combined. Per NPDS, *minor effects* are "minimally bothersome," *moderate effects* suggest need for treatment but are "not life-threatening," and *major effects* are "life threatening or result… in significant residual disability." All NPDS fatality narratives were reviewed.

Results: 35,436 cases were identified, of which 10,650 (30.1%) were <2-years-old and 18,505 (52.2%) were between 2-5-years-old. Amongst those <6-years-old, 29,089 (99.8%) of ingestions were unintentional. For patients 13-19-years-old, 2,996 (76.2%) of ingestions were intentional. 26,391 (74.4%) of patients had no/mild effects. 6 patients (0.1%) < 2-years-old and 19 patients (0.1%) 2-5-years-old had major effects. 2,316 (8.8%) of patients with no/mild effects were admitted to a critical care unit.

Of all cases, 1,460 (4.1%) had hypotension, 4,403 (4.0%) had bradycardia, 991 (2.8%) had drowsiness/lethargy, and 600 (1.7%) had vomiting. 119 (0.3%) developed hypoglycemia. 15 (0.3%) propranolol ingestions experienced seizures and 35 (0.7%) experienced cardiac conduction disturbances. Regarding sotalol ingestions, 8 (2.3%) experienced conduction disturbances.

Amongst all patients, 12,499 (35.3%) received activated charcoal and 364 (1.0%) underwent lavage. 3,839 (10.8%) received intravenous fluids, 362 (1.0%) received glucagon, 69 (0.2%) received vasopressors, and 40 (0.1%) received high-dose insulin. Eight underwent CPR.

There were four fatalities, all of whom were intentional ingestions in patients >10-years-old, and all four sustained cardiac arrest in the pre-hospital setting. Four received vasopressors, three glucagon, two high-dose insulin, and two lipid emulsion therapy. Two deaths were attributed to propranolol, and two to β_1-selective agents.

Conclusions: Reported BAA ingestions in this multi-year national pediatric population caused infrequent toxicity, and no fatalities resulted from an unintentional ingestion. Despite canonical teaching, the frequency of true hypoglycemia was low in this population. Propranolol is known to prolong the QRS interval and induce seizures, however this occurred infrequently. Furthermore, while sotalol prolongs the QTc interval, that was also an uncommon event. Therapeutics beyond decontamination and intravenous fluids were rarely required. 8.8% of patients were admitted to a critical care unit despite having no or mild effects, which suggests an opportunity for cost savings if children with unintentional ingestions can instead be observed in an emergency department or general pediatric floor. Future investigation is warranted into the risk of clinically-significant illness following reported pediatric BAA ingestion.

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294. Toxicity from accidental consumption of delta-8-tetrahydrocannabinol gummies in two pediatric patients

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Background: Delta-8-tetrahydrocannabinol (Δ^8-THC) is a psychoactive isomer of Delta-9-tetrahydrocannabinol (Δ^9-THC), which is commonly referred to as THC. Both compounds are agonists at cannabinoid receptors and have physiologic and psychotropic effects, with Δ^8-THC recognized as being less potent. The molecular structures differ on the location of a double bond. Substances that contain less than 0.3% Δ^9-THC and are derived from hemp are legal under federal law, with Δ^8-THC currently falling under that designation.

Case series: A three-year old male and a five-year old female, both previously healthy siblings from the same household, presented to the emergency department with parents for evaluation of altered mental status approximately twelve hours after presumed large Δ^8-THC ingestions. The parents, who legally purchased two bags of Δ^8-THC gummies (each bag containing 450 mg of Δ^8-THC in total), discovered both previously unopened bags to be empty. Upon presentation to the emergency department, both children were brought to resuscitation bays as they were noted to be stuporous. Physical examination of both children revealed them to be minimally reactive to vigorous physical stimuli with sluggishly reactive and mydriatic pupils. The 5-year old patient was moderately bradypneic at times. Laboratory tests including a CBC, CMP, venous blood gas, ethanol level, salicylate level, and acetaminophen level were all unrevealing. Basic urine drug screens were positive for THC only. Comprehensive urine drug screens were positive for THC and caffeine metabolites. Naloxone was initially administered to both children without appreciable response.

Both patients were admitted to the pediatric intensive care unit for monitoring. The 5-year old female required high-flow nasal canula for a total of 14 hours after admission for persistent bradypnea and hypoxia. The mental status of both patients gradually improved and they were discharged uneventfully on hospital day 3 following social work and child advocacy clearance.

Discussion: Unintentional THC poisonings in pediatric patients are dangerous and potentially life threatening. Δ^8-THC-containing products are widely available over the counter in many states and are not currently considered illegal under federal law based on provisions established in the Agricultural Improvement Act of 2018. Additionally, the rates of unintentional cannabis ingestion in children have increased in states where medical and recreational cannabis are now legal. These products often do not have child-proof packaging and are attractive to minors given the colorful appearance of both the packaging and candies themselves.

Conclusion: We present two cases of accidental Δ^8-THC gummy consumption in pediatric patients leading to prolonged toxic encephalopathy requiring ICU admission. One patient developed respiratory depression and required supplemental oxygen. Due to a current lack of federal regulation, Δ^8-THC products are readily available online and over-the-counter and may constitute a growing number of exploratory pediatric ingestions.

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295. One lick could kill? Symptomatic tetrahydrozoline exposure after child licks eye-drop container

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Background: Tetrahydrozoline is an alpha-2 receptor and imidazoline receptor I-1 agonist that is frequently found in redness-reducing eye drops. Consumption of tetrahydrozoline-containing products can cause bradycardia, hypotension, and sedation.
Case report: A healthy 11-month-old female presented to the emergency department for evaluation of altered mental status. Approximately 30 minutes prior to onset of symptoms, the patient licked the exterior of an expired Visine® tears bottle but did not remove the cap. Her mother immediately retrieved the bottle but noticed that while the cap was intact, there was crystalized material around it. Over the next hour, the patient became increasingly somnolent and was difficult to arouse, which prompted the family to give her a dose of acetaminophen and seek medical attention. Workup, including basic urine drug screen, blood counts, metabolic panel, and COVID-19 and influenza testing, was unrevealing. Patient was initiated on empiric meningitis treatment and transferred to a tertiary care pediatric hospital.
On arrival, the patient's vital signs were as follows: heart rate 104 bpm, blood pressure 112/ 66 mmHg, and rectal temperature 36.0C. She was found to be lethargic but arousable to tactile stimuli, though she would rapidly fall back to sleep after 5-10 seconds. Rapid MRI of the brain was negative, and abdominal ultrasound was negative for intussusception. Comprehensive urine drug screen was sent for liquid chromatography time of flight mass spectroscopy (LC-qTOF) analysis. The patient was admitted to the observation unit overnight with toxicology and neurology consultations.
The patient's mental status returned to her baseline by the following morning. Her LC-qTOF urine drug screen was positive for acetaminophen and tetrahydrozoline.
Discussion: This case report demonstrates the known effects of tetrahydrozoline ingestion in the pediatric population but also provides unique insight into an uncommon form of exposure. Expired liquid medications are more unstable than their solid counterparts, especially eye drops, because of the solvents required for their formulation. Additionally, eye drops contain preservatives to prevent bacterial growth. Over time, these liquids can evaporate and leave behind a crystalized substance; it is possible this concentrated solid contains increased amounts of the active ingredient. In this case, the crystals likely contained a significant quantity of tetrahydrozoline, which is known to precipitate toxicity in children. Alpha-2 and imidazole agonist ingestion is cause for immediate referral in the pediatric population due to rapid onset of bradycardia, bradypnea, hypotension, and somnolence. Therefore, prompt recognition and referral after these exposures are paramount, as systemic toxicity may ensue.
Conclusion: Crystalized liquid medications, including tetrahydrozoline eye-drops, can cause toxicity if ingested, especially in the pediatric population.

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296. All set without Chemet®: the challenge of treating a pediatric exposure to lead paint during a shortage of succimer

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Background: Ingestion of lead particulates from older housing remains a common source of lead exposure in the United States. Oral DMSA (succimer) is a first-line therapy for patients requiring chelation due to its efficacy and safety profile. As a result of a recent nationwide supply shortage of succimer, difficult clinical decisions are now being made regarding how to allocate this scarce resource. This report emphasizes the importance of bowel decontamination and rapid serial blood lead levels prior to considering chelator agents.
Case report: A 30-month-old female was admitted to the hospital for a blood lead level (BLL) of 57 mcg/dL. The patient's BLL was 21 mcg/dL 3 months prior and lead paint from her family's new residence was the likely source of exposure. The family acquired safe housing with the help of the state lead program during the admission. The patient's mother reported the patient had increasing fatigue for 2-3 weeks prior to presentation and poor appetite for the previous 9 months. On hospital presentation, the patient appeared asymptomatic with no neurologic or gastrointestinal symptoms. Her lab workup was notable for iron deficiency anemia. An abdominal x-ray showed radio-opaque particles in her abdomen, and whole bowel irrigation (WBI) was performed with polyethylene glycol for 24 hours. Repeat imaging showed no residual radio-opaque particles, and the patient was discharged to a safe living environment with iron supplementation. Due to oral succimer shortage, chelation was held while the team evaluated several other pediatric lead exposure cases and determined the most appropriate allocation of this rare resource to the region. The patient remained removed from the source of exposure and BLL measurement was performed within one week from admission and again at day #14 and two months post-WBI. BLLs resulted at 40 mcg/dL, 38 mcg/dL, and 32 mcg/dL, respectively. The patient remains in good health and no further treatment was required except for iron supplementation.
Discussion: Treatment recommendations for asymptomatic children with BLLs 45 mcg/dL to 69 mcg/dL include consideration for chelation with succimer. This case presented a challenge due to lack of adequate succimer supply while assessing multiple potential candidates for chelation at one time. Alternative chelators that could have been considered include calcium disodium EDTA, d-penicillamine, and DMPS, which are all less ideal due to administration concerns, side effect profile, cost, and availability. In this instance, the patient trended below the threshold for chelation within one week of WBI and a positive outcome was achieved without the use of succimer.
Conclusion: This case highlights the importance of WBI and exposure source control as the primary treatment for elevated lead levels. The extenuating circumstances that led to the lack of chelation in this case suggests that it may be time for clinicians to re-evaluate the practice of inpatient chelation of elevated BLLs in patients without encephalopathy. We should practice responsible prescribing of orphan drugs that are at risk of severe shortage, as well as address the historical trend of constantly being without appropriate supply of these scarce resources.

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297. Weaken me softly: hypermagnesemia from chewable saline laxatives due to exploratory ingestion in a child

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Background: Magnesium hydroxide is commonly found in over-the-counter preparations for relief of gastrointestinal symptoms. It has a relatively low oral bioavailability, and should not cause hypermagnesemia from therapeutic use. However, risk of

hypermagnesemia remains high when large amounts are consumed, especially from exploratory pediatric ingestions of formulations that are flavored and made easy for ingestion. We report a case of symptomatic hypermagnesemia in a pediatric patient after he consumed Dulcolax® SoftChew, which contains 1,200 mg magnesium hydroxide per chew, and is labeled for use in 4 years and older.

Case report: A mother of a 4-year-old boy weighing 18 kg called to the Poison Center because he ate 20 Dulcolax® SoftChew some time prior to the call. He had at least 2 episodes of loose stools, and 3 episodes of emesis. He seemed lethargic and said, "Mommy, this is not my house." The child was referred to a local emergency department for further assessment. Initial vitals showed a heart rate of 105 beats/min, blood pressure of 92/58 mmHg, 22 respirations per minute, and normal saturation on room air. Initial serum magnesium level was 4.2 mg/dL, pCO2 of 42 on venous blood gas, and serum creatinine of 0.5 mg/dL. The evaluating team reported he was more alert, but had mild hyporeflexia on exam. With this information, the Poison Center recommended intravenous calcium administration and following serial serum magnesium and venous blood gas. He received 60 mg/kg IV calcium gluconate and was transferred to a tertiary pediatric center. Repeat serum magnesium level was 3.6 mg/dL before transfer.

On admission to the pediatric hospital, he remained alert and hemodynamically stable despite persistent diarrhea and mild hyporeflexia (1 of 4 patellar reflexes bilaterally). Serum magnesium was 3.2 mg/dL at that time; serial pCO2 measurements were within normal limits. Electrocardiograms never showed cardiac dysrhythmias and lowest serum bicarbonate was 23 mmol/L. No additional doses of calcium gluconate were given. About 24 hours after, serum magnesium level was 2.3 mg/dL. Diarrhea and hyporeflexia resolved, and the child was subsequently discharged.

Discussion: It is estimated that 61 mg/kg of elemental magnesium can raise the serum magnesium level by 0.5 mEq/L. Therefore, the 24 gm of magnesium hydroxide consumed in our case, which is equivalent of 577 mg/kg of elemental magnesium, can potentially raise serum magnesium level by 4.7 mEq/L. Hypermagnesemia can mimic calcium blockade, leading to muscle weakness, manifesting hyporeflexia and respiratory depression from a hypokinetic diaphragm. The main treatment modality is intravenous calcium administration, but exact dosing regimen, especially in the pediatric population, is unclear. Our case received 60 mg/kg of calcium gluconate 10%, which is indicated to treat hemodynamic instability of calcium channel blocker toxicity, and had successful resolution of hyporeflexia.

Conclusion: Symptomatic hypermagnesemia may occur from exploratory ingestions of chewable saline laxatives. Pleasantly flavored preparations may facilitate larger exposures in children. Consequently, such preparations should be stored safely out of the reach of children. Symptomatic hypermagnesemia in this case was managed successfully with a single dose of intravenous calcium gluconate.

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298. Can single dose pediatric ingestions of sulfonylureas be managed at home?

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Background: Sulfonylureas are a class of oral anti-glycemic medications that act as insulin secretagogues by stimulating insulin release from pancreatic beta cells. These medications have been worrisome for delayed and prolonged hypoglycemia in accidental pediatric ingestions. While published guidelines often recommend a 24-hour hospital observation period, the Oregon Poison Center has historically managed select patients at home to reduce resource utilization. The objective of this study is to describe management and outcomes of home-managed pediatric sulfonylurea exposures and to determine characteristics of certain ingestions that may be appropriate for home monitoring.

Methods: This is a retrospective chart review of pediatric ($\leq$5 years) sulfonylurea ingestions reported to a single poison center over a 19-year period (2002 – 2020). 493 individual cases were reviewed for age, quantity of ingestion, witnessed or unwitnessed ingestions, disposition, hypoglycemia ($<$60 mg/dL), and severe events including seizures or coma. Cases where all missing pills were found or where another agent was identified were excluded.

Results: 477 cases met inclusion criteria. The majority of ingestions occurred in children age 13-24 months (326, 68%).136 (29%) cases were initially managed at home. Of these, 105 (77.2%) were ingestions of $\leq$1 tablet, with 61 (45%) being witnessed and 44 (42%) unwitnessed. In unwitnessed ingestions, pills were either missing with a suspected ingestion, or the ingested pill could not be definitively identified. The remaining ingestions had an unknown quantity or were $\geq$1 tablet. Additional characteristics determining appropriateness of home monitoring included parental comfort with monitoring for hypoglycemia, proximity to a health care facility (HCF), access to a glucometer for blood glucose monitoring, and SPI gestalt. 125 (92%) of these cases were successfully monitored at home, with 11 (8%) ultimately referred to a HCF. Factors determining need for referral included: development of signs concerning for hypoglycemia (child became symptomatic with lethargy, shakiness or diaphoresis), hypoglycemia measured on glucometer ($<$60 mg/dL), large fluctuations in glucose levels after meals, or parental concern for adequate home monitoring. Of those referred, 4% (5) developed uncomplicated asymptomatic hypoglycemia, with two requiring octreotide. None experienced serious adverse events, seizures, or coma.

Conclusions: In this retrospective, single poison center chart review, we report 136 cases of pediatric sulfonylurea ingestions with initial home monitoring, the majority of which were successfully monitored at home without any reported adverse events. 11 cases "failed home monitoring," as defined by referral to a healthcare facility; of these, 5 developed hypoglycemia, and none experienced serious adverse events. Our findings suggest that it may be possible to monitor select pediatric sulfonylurea ingestions at home with low risk. Limitations of the study include its retrospective nature and the lack of pre-defined criteria or a specific protocol for recommending at-home monitoring. Future prospective studies might define characteristics predictive of success with managing some of these patients at home, leading to decreased HCF utilization and costs.

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299. So you think you know what happened? Using ICD codes to evaluate pediatric emergency department opioid encounters: are they accurate?

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Background: Over 80,000 Americans lost their lives to an overdose in 2020. Most of these deaths, which have increased by more than 400% since 2000, are opioid-related. Numerous nonfatal opioid exposures and events occur annually, causing high levels of morbidity as well as billions of dollars in health care expenditures and other costs. Effective tracking and evaluation of opioid overdose morbidity and mortality is necessary for identification of trends, education needs, and appropriate interventions. Use of International Classification of Disease (ICD) diagnosis codes for analysis of overdose events has been shown to be fairly specific but insensitive in general Emergency Department (ED) settings. The positive predictive value of ICD codes has not been well evaluated in a pediatric population nor has there been comparison between ICD-9 and ICD-10 codes in this population.
Objective: To evaluate the positive predictive value of ED diagnosis codes in correctly identifying opioid overdoses and related events in a pediatric population
Methods: A retrospective chart review of patients 0-18 years seen in 16 EDs across one regional healthcare system from 2014 through 2020. Patients were initially identified by ICD-9 and ICD-10 discharge codes (codes for opioid use, opioid abuse, opioid dependence, opioid withdrawal, poisoning by opioid, adverse effect of opioids) and then followed by manual chart review. ICD-9 and ICD-10 codes were compared for relative accuracy as well.
Results: 1198 patients were identified by an ICD code indicating opioid overdose or exposure, opioid dependence, opioid withdrawal, and/or for opioid detoxification/treatment needs. Of these, manual chart review determined that 407 (34%) did not have a clinical presentation consistent with the coded event. ICD-9 codes were more effective at identifying opioid events in the younger population (0-5 yrs), and were more accurate than the newer ICD-10 codes (76.7% v. 62% accurate, $z = 4.7635$, $p < .0001$). Image 1 shows the number of cases broken down by age and by opioid exposure identified after chart review. Image 2 compares ICD-9 and ICD-10 code results.
Conclusions: Accurately identifying patients who have experienced an opioid overdose or opioid related event is crucial in monitoring the impact of the current opioid crisis on the pediatric population. This review of one health system found large discrepancies between ICD codes indicated in discharge data and actual overdose events identified by independent chart review. There is less accuracy since the introduction of ICD-10 codes near 2016. Utilizing only ICD codes to quantify opioid exposures and events has unexpectedly low positive predictive value. Given the necessity of accurate information to track and appropriately respond to this continuing crisis, changes in coding practices and in diagnosis code clarity are urgently needed.

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300. The young in the midst of the opioid crisis: 2014-2020 pediatric opioid events in the emergency departments of one regional healthcare system

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Background: Overdose is the leading cause of injury death in the United States, and this state has been as high as 4th nationally for overdose deaths. Toxicologic ingestions are common in children and opioids are among the most dangerous ingestions. Recent national data showed that pediatric hospitalizations for opioid poisonings nearly doubled from 1997-2012, and pediatric ICU admissions for opioid exposures increased 47% between 2012-2015.
Objective: To describe the characteristics of children seen for opioid-related events or conditions in the Emergency Departments(EDs) of a large regional U.S. healthcare system.
Methods: We systematically collected demographic and clinical data from the electronic medical records of patients 0-18yrs seen in any of the 16 EDs in one healthcare system using ICD9/ICD10 coding for opioid poisoning, opioid abuse, opioid withdrawal, or opioid dependence from 2014-2020. This healthcare system accounts for approximately 55% of the ED care in this state.
Results: 1198 patients were identified by ICD codes and 66%(791) of those were confirmed by chart review as experiencing an opioid-related event. The age distribution is bimodal, 33% 0-5yrs and 62% 13-18yrs (Image 1). 55% were female. 92% of exposures occurred in the home (immediate or extended family) and only 0.4% occurred in school settings (two exposures seen at one school in a singular event where no naloxone was required). Events were concentrated in the state's urban and suburban population center(Image 2). For medication exposures, over 80% of substances were not the patient's: 74%family, 19%self, 5%friend, 1%pet. The substance breakdown is presented in Table1. In 36%, the exposure was a self-harm attempt. Naloxone was administered en-route to or while in the ED in 27%. 30% were admitted for behavioral health treatment and 52% were hospitalized for medical stabilization. 21% of those admitted to a medical service required ICU-level care. There were 2 fatalities (16,18yrs). 130(16%) patients presented requesting detoxification, recovery treatment, and/or with opiate withdrawal symptoms. All of these were 14-18yrs and 60% were discharged from the ED with placement in a detox, treatment setting, or with an outpatient referral. This is an improvement from 2014-2016 data (38%). Notably, only 4 (3%) were started on buprenorphine in the ED.
Conclusions: Children with opioid related ED visits in this single large regional healthcare system had a bimodal age distribution, mostly ingested medications belonging to family members, ingestions occurred largely in the home, and 52% were admitted for further medical or behavioral health care. These results support redirecting anticipatory guidance to include screening for opioids in the home, education on the risks of opioid exposure in children, and access to naloxone rescue kits in homes with opioids and children present. Increased access to detox and/or recovery services and to ED access to buprenorphine (medication assisted treatment) for adolescents are also needed. Initiation of buprenorphine in ED settings is becoming standard in many ED settings, this pattern is not being seen with pediatric patients in this geography. Further evaluation of how current overdose prevention and treatment access strategies can target those at risk is necessary, with attention paid to the pediatric population.

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301. Caustic ingestions: acidic vs. basic ingestions

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Background: Caustic agents are commonly encountered in clinical practice. In theory, alkali agents can cause more severe depth of injury because of their ability to cause liquefactive necrosis, in contrast to the coagulative necrosis in acidic ingestions. Despite some data that asymptomatic exploratory ingestions in children with alkali agents can be safely managed with observation alone, there is some debate if that is an adequate approach for acidic ingestions. This study sought to determine if acids and bases pose similar risk with regards to developing symptoms or severe ingestion

Methods: This retrospective, multicenter study evaluated caustic ingestions occurring between 1 January 2014 through 31 December, 2020 at 9 locations in three countries. Subjects were identified via search of ICD 9 and ICD 10 diagnosis. Symptoms were defined as the presence of pain, dysphonia, drooling, or need for intubation (other than for an EGD). Patients were considered to have non-significant injuries if an esophagogastroduodenoscopy (EGD) was performed and grade 0, I, or IIa lesion was present, or if follow-up information is noted at least 30 days after the initial injury and the patient had no surgical interventions at that time. Subjects were excluded if there was a mix of caustic ingestions (acid and a base ingested), or if the agent was unknown.

Results: A total of 197 subjects were identified who met inclusion criteria, with a median (IQR) age of 17 (3-30) years. Ingestions of acidic substances were less common than ingestions of basic substances (14.7% vs. 85.3%). Symptoms were present in 97 (51.3%) of cases. One month follow up data or EGD was available for the majority (80.2%) of subjects. Among acidic ingestions, 20/27 (74.1%) had symptoms, compared with 77/162 (47.5%) of basic ingestions; compared with bases, acids were 1.56 times more likely to produce symptoms (95% CI 1.2-2.1). Significant injury was noted in 6/132 (4.55%) of basic ingestions, and 2/26 (7.7%) of acidic ingestions; $p = 0.6$. There was no difference in the rate of performing an EGD between caustic or acidic substances.

Discussion: In this study, we did not find any significant difference between acidic and basic ingestions. While it is possible there is a small difference, in order to have an 80% power to detect a significant difference, using these same percent risk identified in this study, and adding in the standard add-in of 10% for loss of follow-up, drop-outs, etc., a total of 2029 subjects would be needed.

Conclusion: In this study, we failed to identify a clear difference between acid and basic ingestions, with regards to clinically significant injuries. The number of subjects needed to determine if any small difference is present, would be large, and practically impossible to perform.

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