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ANNUAL MEETING ABSTRACT

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Original Research

1. Pilot Trial of Lipid Rescue in a Swine Model of Severe Nifedipine Toxicity

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Background: Animal studies and human case reports show promise of lipid rescue for refractory calcium channel antagonist (CCA) toxicity. However, lipid therapy has not been studied for nifedipine, a dihydropyridine CCA.
Hypothesis: Lipid rescue will restore circulation following severe nifedipine intoxication in a swine model.
Methods: This IACUC-approved pilot study utilized five swine that were sedated with alpha-chloralose, mechanically ventilated, and instrumented for drug delivery and hemodynamic measures. After stabilization and basal measures, nifedipine (0.0175 mg/kg/min) was infused until imminent cardiac arrest (seizure, end tidal CO_2<10 mmHg or bradydysrhythmia). Animals then received a 17 ml/kg 20 % lipid bolus via central catheter. Lipid circulation was visually confirmed by the presence of fat in peripheral arterial blood. Hemodynamics were continuously monitored until 10 min after lipid bolus. Surviving animals were euthanized. Pre- and post-lipid treatment parameters were analyzed using unpaired *t* test ($p<0.05$ significant).
Results: Nifedipine toxicity was characterized by vasodilatory hypotension, impaired contractility, and tachycardia with terminal bradycardia (see table). The mean time to imminent cardiac arrest from start of nifedipine infusion was 232±77 min. Lipid treatment did not improve or restore circulation in any animal.
Discussion: There was no benefit from lipid rescue in this model of nifedipine toxicity. Limitations to the results include potential excessive toxicity, inadequate lipid dose, insufficient observation time for treatment effect, or a direct adverse effect of lipid. Further study of earlier treatment or different lipid doses is warranted.

Table (Murphy Abstract): Hemodynamic parameters (mean ± SD) vs time (in minute)

	Basal	60	120	180	Pre-Lipid	Lipid +10
HR (bpm)	63±6	128±9	157±25	158±23	98±91	64±91
MAP (mmHg)	80±5	48±11	50±9	37±11	27±10	24±2
SVR (dyne-s/cm^5)	616±63	346±74	259±200	426±168	558±261	164±205*
CVP (mmHg)	9.8±1.1	14±1.7	12±2.9	14±1.5	16±1.4	16±2.3
CO (L/min)	9.2±1.0	8.4±4.6	13.6±7.2	5.8±5.8	2.2±1.7	0.4±0.8
SV (ml)	146±8	65±34	117±83	34±31	13±7	4±5*

*$p<0.05$

2. Pretreatment with Intravenous Lipid Emulsion Reduces Mortality from Cocaine Toxicity in a Rat Model

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Background: Intravenous lipid emulsion (ILE) is efficacious in the treatment of severe toxicity from local anesthetics and as well as other lipophilic drugs. Given that cocaine has a lipid partition coefficient of 2.3, its toxicity may be helped by ILE administration.
Purpose: The purpose of this study was to determine ILE's effect on cocaine-induced mean arterial pressure (MAP) changes and mortality in a rat model compared with control.
Methods: This is an experimental animal model of cocaine toxicity using male Sprague Dawley rats. Twenty subjects were sedated, ten animals received ILE and ten received normal saline (NS) in the same 15 ml/kg dose, this was followed by a 10 mg/kg bolus of intravenous cocaine. Continuous hemodynamic monitoring included intra-arterial blood pressure, heart rate and electrocardiogram tracing. End points included a sustained undetectable MAP or return to baseline for 5 min. Two tailed *T* tests were used to compare the groups on a number of hemodynamic parameters.
Results: Seven of ten NS animals died and 3/10 ILE animals died. Odds ratio for mortality in NS vs ILE group was 9.33 (95 % CI 1.1934–72.99, $p=0.033$). Between groups, there were no differences in baseline MAP, maximum MAP reached, or time to maximum/minimum MAP after cocaine exposure. The NS group reached a significantly lower MAP than the ILE group after cocaine exposure ($p=0.001$).
Discussion: ILE blunted hypotensive effects and decreased cocaine-induced death compared with NS in this rat model. Given that there is no antidote for severe cocaine toxicity and ILE is a relatively inexpensive and safe treatment, this would represent a significant improvement in our current therapy for this exposure, which is supportive care only. Our small sample size limits the interpretation of mortality data.
Conclusions: ILE should be investigated further as a potentially life-saving adjunct in the treatment of severe cocaine toxicity in humans.

Table (Carreiro Abstract): Hemodynamic data for ILE and saline groups, mean (SD) given. *MAP* = mean arterial pressure, *Min* = Minimum, *Max* = Maximum

	Baseline MAP before cocaine (mmHg)	Overall Delta MAP after cocaine (mmHg)	Max MAP after cocaine (mmHg)	Time to Max MAP (s)	Min MAP after cocaine (mmHg)	Time to Min MAP (s)
Saline	86 (7.3)	−53.0 (38.1)	95.3 (29.3)	14.7 (3.5)	14.7 (8.5)	157.7 (73.2)
ILE	86.2 (8.4)	−20.0 (34.6)	107.2 (13.4)	30.6 (45.3)	46.8 (22.3)	133.4 (116.3)
***p* value**	0.951	0.058	0.262	0.298	0.001	0.585

3. A Swine Model of Severe Propranolol Toxicity Permitting Direct Measurement of Cerebral Oxygen Tension

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Background: High-dose insulin (HDI) treatment for beta-blocker toxicity is a standard therapy, but needs further study, especially cases of persistent hypotension despite active HDI.
Purpose: The objective was to develop a swine model of propranolol (P) toxicity with persistent hypotension despite treatment with HDI and to develop means to measure cerebral oxygen tension (PbrO2).
Methods: Eight anesthetized adult Yorkshire pigs were instrumented with a tracheostomy, Swanz–Ganz catheter, arterial catheter, and intra-cerebral pressure and oxygen monitor. Two pigs had unique doses to derive the final protocol. A 0.5 mg/kg bolus of P was given, then a 0.25 mg/kg/min infusion (gtt) until the initial point of toxicity (POT), defined as 25 % reduction from baseline MAP×heart rate (HR). At the initial POT a 20 ml/kg normal saline bolus (NS) was given along with a 1 ml/kg/h NS gtt and a 10 units/kg/h insulin gtt. The P infusion was then set at 0.125 mg/kg/min for 60 min, then 0.1875 mg/kg/min for 30 min, and finally to 0.2188 mg/kg/min for the rest of the 240-min protocol. Group 2 pigs then received a norepinephrine (NE) gtt after a second POT, MAP <50 mmHg. NE was titrated from 0.1 to 0.3 mcg/kg/min to maintain subsequent MAPs >50 mmHg. Cardiac output, HR, MAP, PbrO2, and intracranial pressure were recorded every 5 min. Systemic vascular resistance, potassium, and glucose were also measured. Surviving pigs were euthanized.
Results: One pig developed a tachyarrhythmia prior to protocol. Five pigs completed the protocol with three pigs in group 1 and two in group 2. Four pigs reached the second POT. The range of PbrO2 recordings for group 1 was 12.7–48.5 mmHg and 9.2–26.2 mmHg for group 2.
Discussion: This model allowed serial physiologic measures including PbrO2. Limitations include a small sample size and a 240-min protocol.
Conclusion: We report a swine model of P toxicity with hypotension despite HDI, in which serial measures including PbrO2 are achieved.

4. Signs, Symptoms, and Functional Impairment During Recovery from Copperhead Snakebite

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Background: Copperhead snake (*Agkistrodon contortrix*) envenomation produces predominantly local tissue effects in the envenomated limb. No published studies have measured recovery from these envenomations.
Research questions: How do the signs, symptoms, and functional status of patients envenomated by copperhead snakes vary over time? What patient- and clinician-reported outcome measures are responsive and useful to study this population?
Methods: This is a multicenter prospective observational study of non-pregnant adults envenomated on a limb, distal to the elbow or knee, by a copperhead snake. Patients were enrolled regardless of antivenom administration. Assessments were made 3, 7, 14, 21, and 28 days after envenomation using the Disorders of the Arm, Shoulder and Hand (DASH), Lower Extremity Functional Score (LEFS), Patient-Specific Functional Scale (PSFS), Work Productivity and Activity Index: Special Health Problem (WPAI:SHP), Patient Global Impression of Change (PGIC), Patient Global Assessment of Recovery (PGAR), and SF-36 (acute) instruments. Grip strength, 7.62-m walking speed, and swelling (figure-of-eight) were measured. Analgesic use and return to work were assessed. Pain was assessed using an 11-item Likert scale.
Results: Data from 16 patients, including 13 treated with antivenom, were available for this preliminary analysis. Measures of pain, analgesic use, swelling, and functional impairment all showed marked abnormalities 3 and 7 days after envenomation. Most subjects had little or no residual abnormality by the 28-day assessment. The degree of abnormality measured at 14 and 21 days post-envenomation differed by the health outcome assessed. Percent change over time was greatest for the DASH, WPAI:SHP, and PSFS instruments and grip strength measurement.
Discussion: The small number of patients managed without antivenom in these preliminary data did not provide sufficient power to detect treatment effect.
Conclusion: In this preliminary analysis in which most patients received antivenom, victims of copperhead snakebite suffer pain, swelling, and functional impairment lasting 7–28 days.

5. Diethylene Glycol Metabolites Are Associated with Diethylene Glycol Poisoning in Humans

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Introduction: In 2006, an outbreak of acute kidney injury (AKI) and neurotoxicity from diethylene glycol (DEG) occurred in Panama. Biological samples from participants in a case–control study were shipped to CDC and stored until analyzed in 2010.
Hypothesis: The DEG metabolites hydroxyethoxyacetic acid (HEAA) and diglycolic acid (DGA) are associated with DEG poisoning.
Methods: Samples with sufficient volumes of serum, urine and cerebrospinal fluid (CSF) were analyzed by GC/MS for DEG, hydroxyethoxyacetic acid (HEAA), diglycolic acid (DGA), ethylene glycol (EG), glycolic acid (GA), and oxalic acid (OA). Median and range were calculated. The Wilcoxon rank sum test (exact p values) and bivariable exact logistic regression were used in SAS v9.2 to analyze serum/urine data.
Results: Twenty case and 20 control serum samples, 11 case and 22 control urine samples, 9 case CSF samples and 1 CSF sample from a bio-bank used as a blank were analyzed. Descriptive data is presented in the table. Regression analyses demonstrated associations between case status and: (1) serum OA and serum HEAA (both OR=14.6, 95 % CI=2.8–100.9), (2) serum DGA and urine DGA (both OR>999, exact $p<0.0001$), and (3) urinary GA (OR=0.057, 95 % CI=0.001–0.55).
Discussion: DEG metabolism yielded significantly elevated HEAA (serum) and DGA (serum and urine) concentrations among cases. As urinary GA elimination decreased from AKI in cases, serum GA likely increased, which was then converted to serum OA. Analytical methods need further validation.
Conclusion: Serum DGA, urine DGA, and serum HEAA concentrations are associated with human DEG poisoning and may be valid biomarkers of DEG-associated illness.

Table (Schier Abstract): Diethylene glycol and metabolite levels in cases and controls

Medium (mcg/mL)	Diethylene glycol	Ethylene glycol	Glycolic acid	Oxalic acid[a]	Hydroxyethoxyacetic acid	Diglycolic acid						
Serum	Cases (n=20)	Controls (n=20)	Cases (n=20)	Controls (n=20)	Cases (n=20)	Controls (n=20)	Cases (n=20)	Controls (n=20)	Cases (n=20)	Controls (n=20)	Cases (n=20)	Controls (n=20)
	0.04; [<LLQ, 0.2]	<LLQ; [<LLQ, 0.2]	<LLQ; [<LLQ, 0.2]	<LLQ; [<LLQ, <LLQ]	2.8; [2.4, 3.3]	2.74; [2.2, 4.2]	12.96 [7.6, 30.9] *	5.24; [3.6, 17.7]	1.44; [0.5, 64.8] *	0.702; [<LLQ, 2.0]	40.73; [22.6, 75.2] *	<LLQ; [<LLQ, <LLQ]
Urine[b]	Cases (n=11)	Controls (n=22)	Cases (n=11)	Controls (n=22)	Cases (n=10)	Controls (n=22)	Cases	Controls	Cases (n=10)	Controls (n=22)	Cases (n=10)	Controls (n=22)
	<LLQ; [<LLQ, 0.7]	<LLQ; [<LLQ, 106]	<LLQ; [<LLQ, 9.6]	<LLQ; [<LLQ, 1.2]	3.00; [1.2, 82.9] *	14.73; [1.9, 43.3]	ND	ND	<LLQ; [<LLQ, 0.4]	<LLQ; [<LLQ, 547]	28.71; [14.0, 118.4] *	<LLQ; [<LLQ, 43.3]
CSF[a,c]	Cases (n=9)	Blank (n=1)	Cases (n=9)	Blank (n=1)	Cases (n=9)	Blank (n=1)	Cases	Controls	Cases (n=9)	Blank (n=1)	Cases (n=9)	Blank (n=1)
	<LLQ; [<LLQ, 4.8]	<LLQ	<LLQ; [<LLQ, <LLQ]	<LLQ	2.8; [1.8, 3.8]	2.91	ND	ND	1.0; [<LLQ, 121]	<LLQ	2.03; [<LLQ, 7.5]	<LLQ

<*LLQ* less than the lower limit of quantitation, *ND* not determined
*p<0.0001 by Wilcoxon rank sum test
[a]Urinary and CSF oxalic acid concentrations not able to be measured due to strong matrix effects encountered during analysis
[b]There was insufficient urine volume to complete the glycolic acid, hydroxyethoxyacetic acid and diglycolic acid assays
[c]No CSF control specimens were available. Data on the single CSF specimen obtained from a bio-bank (pooled specimen from 30 to 40 donors) used to develop the matrix blank is presented for comparison. All cases had neurological signs and symptoms

6. Borderline and Long QT Interval with Medications Associated with QT Prolongation in Adolescent Athletes

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Purpose: The purpose is to determine whether adolescent athletes taking QT-prolonging medications are more likely to display a borderline long or long QT interval.
Methods: Preparticipation exams were performed on 484 adolescents. This consisted of a physical exam, 12-lead ECG, and health history requiring subjects to list all current prescription and over-the-counter medications. ECGs were interpreted by a pediatric cardiologist. ECGs with heart rate <60 or >100 were reviewed using Bazett's correction formula. Borderline long QT was defined as QTc of 450–500 ms in males and 460–500 ms in females. Long QT was defined as QTc>500 ms. QT-prolonging medications were identified from the Arizona Center for Education and Research on Therapeutics list of QT-prolonging medications. Fisher's exact tests were used to compare the proportion of subjects with a borderline QTc that were versus were not taking QT-prolonging medications. Males and females were analyzed separately. A multiple linear regression analysis was used to estimate the difference in QTc length among subjects taking QT-prolonging medications.
Results: None of the athletes exhibited a QTc>500 ms. A borderline long QT was identified in 2.99 % [95 % CI 0.98–6.85 %] of the female and 8.60 % [95 % CI 5.74–12.26 %] of the males. Median QTc length was 425 ms [range, 373–478] and 421 ms [range, 358–487] for females and males, respectively. In both the female and male cohorts, there was no difference [p>0.999] in the proportion of subjects with a borderline long QTc among subjects taking the QT-prolonging medications compared to those subjects not taking the medications (see Table 1). After controlling for gender, age, and their interaction, there was no difference in QTc interval among subjects taking the medications compared to those not taking the medications [mean difference −0.72 ms, 95 % CI–5.92 to 4.35 ms, p=0.8318].
Conclusion: QT-prolonging medications, when taken at their therapeutic dose, were not significantly associated with the presence of a borderline/long QTc interval. Further research is needed to evaluate the effects and risks of these drugs during exercise.

Table (Hoyte Abstract): Proportion of subjects with a borderline long QT

		Borderline long QT	Normal QT
Females	**Meds**	0 (0 %)	10 (100 %)
	No meds	5 (3.18 %)	152 (96.82 %)
Males	**Meds**	2 (7.41 %)	25 (92.59 %)
	No meds	25 (8.71 %)	262 (91.29 %)

7. The Naloxone Trigger: An Emergency Department Series

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Background: Medication errors are the most common form of medical error. "Trigger tools" have been identified as effective methods for identifying medication errors.
Research question: This study compared the naloxone trigger to a voluntary reporting system for identifying opioid-related adverse events in the Emergency Department. The characteristics of patients identified by the naloxone trigger are described.
Methods: We targeted patients who received opioids in the ED prior to naloxone. Data were extracted from an electronic database regarding demographics, medications and outcomes. A chart review was conducted for patient symptoms, and each case was assigned an NCC-MERP category of harm. This study received IRB approval.
Results: From October 2009 to December 2011, 354,784 adult patients were treated in two university-affiliated urban emergency departments. During this period, 1,213 doses of naloxone were administered, with 63 patients receiving naloxone after opioids in the ED. The mean patient age was 57.9 years (SD 21.5). Women and whites accounted

for 60.3 and 69.8 % of the population, respectively. Only 7.9 and 12.7 % reported home opioid and home sedative use. The most common indications for naloxone administration were depressed mental status, hypoxia, respiratory depression, hypotension, apnea, and bradycardia (in decreasing order). The NCC-MERP classification is listed in Table 1. None of the patients in this series were identified by the voluntary error reporting system

Discussion: In this study, 19 life-threatening opioid adverse drug events were identified using the naloxone trigger. In contrast, the voluntary medication error/adverse event reporting system failed to capture any of these cases.

Conclusions: Overall, iatrogenic opioid-associated adverse events are rare in the emergency department setting. Voluntary reporting systems may fail to identify these adverse events entirely. The naloxone trigger can be used to target opioid-related adverse events, which must be considered a priority by quality improvement/medication safety programs.

Table (Babu Abstract): Percentage of cases by NCC-MERP classification of adverse drug events

Category	Definition	*N* (%)
A	Circumstances that have the capacity to cause error	11 (17.5 %)
E	An error [or adverse drug event] occurred that may have contributed to or resulted in temporary harm to the patient and required intervention	24 (38.1 %)
H	An error [or adverse drug event] occurred that required intervention necessary to sustain life	19 (30.2 %)
Unknown	An error [or adverse drug event] occurred that required intervention necessary to sustain life	9 (14.2 %)

8. A Missed Opportunity for Safe Opioid Use Using Electronic Pharmacopeia

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Background: Errors in prescribing of high-risk medications, such as extended-release or long-acting (ER/LA) opioid formulations, remain an important cause of patient morbidity and mortality. Prescribing errors often relate to the failure to note warnings regarding contraindications and drug interactions. Many physicians utilize electronic pharmacopeia (EP) to improve ordering of ER/LA opioids, which carry a class-wide "black box" warning.

Purpose: The purpose of this study was to assess the ability of commonly used apps to provide accurate safety information about the boxed warning for ER/LA opioids.

Methods: We evaluated a convenience sample of six popular EP apps available for the iPhone and an online reference for the presence of relevant safety warnings. Two evaluators independently reviewed each program. We accessed the dosing information for each of six ER/LA medications and assessed for the presence of an easily identifiable indication that a boxed warning was present, even if the warning itself was not provided. The level of prominence of precautionary information was classified based on the appearance of a warning: (1) visible in line with dosing information, (2) visible but listed separately, (3) not visible but listed separately, (4) warning not available.

Results: Each program provided a consistent level of warning information for each of the six ER/LA medications. Only 2/7 programs placed a warning in line with dosing information (level 1). Three of the seven programs offered level 2 warning. One of the seven offered level 3 warning. One program made no mention of a boxed warning. Agreement on classification by the evaluators was 100 %.

Discussion: Isolation of important safety warnings, perhaps to reduce alert fatigue, may increase the likelihood that a potentially important warning is missed and a dangerous prescription is provided.

Conclusion: Most EP apps do not place warnings ahead of or on the same screen as prescribing information and represent a missed opportunity to improve prescribing practices.

9. Transaminase and Creatinine Kinase Levels in Acetaminophen Overdose and Rhabdomyolysis

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Background: Delayed presentations of acetaminophen (APAP) hepatotoxicity and rhabdomyolysis present with elevated transaminases. Differentiating the etiology can be difficult in patients where history is limited.

Hypothesis: Comparing ratios between AST, ALT, and creatinine kinase can differentiate APAP hepatotoxicity from rhabdomyolysis.

Methods: Retrospective chart review of patients from 2006 to 2011 with a discharge diagnosis of APAP toxicity or rhabdomyolysis was performed. Subjects were divided into three groups: rhabdomyolysis and APAP overdose (all subjects vs only those with undetectable serum APAP concentrations). Median ratios (interquartile ratio, IQR) of selected laboratory values are presented and analyzed with non-parametric testing.

Results: Five hundred fifty-five subjects with rhabdomyolysis and 240 subjects with APAP overdose were identified. Excluding those with incomplete data resulted in 116 in the rhabdomyolysis group, 40 and 9 in the APAP group (all vs undectable, respectively). AST/ALT ratios in the three groups were 1.56 (IQR, 1.08–2.08), 1.36 (1.12–1.67), and 1.3 (1.24–1.57), respectively. CK/AST ratios in the three groups were 19.24 (9.9–36.8), 5.49 (1.83–15.3), and 3.21 (1.40–4.25) , respectively. CK/ALT ratios in the three groups were 30.96 (11.81–66.7), 7.0 (1.79–25), and 4.1 (1.77–5.5) , respectively. Differences in AST/ALT ratios were not significantly different between the three groups ($p=0.24$). CK/AST ratios were significantly different between the rhabdomyolysis group and the APAP (all) group ($p<0.001$) and the APAP (undetectable) group ($p=0.002$). CK/ALT ratios were also significantly different between the rhabdomyolysis group and the APAP (all) group ($p<0.001$) and the APAP (undetectable) group (0.002).

Discussion: Both the CK/AST and CK/ALT ratios were significantly larger in patients with rhabdomyolysis. Elevated CK/AST or CK/ALT ratios may aid in the decision-making process when deciding when to treat with NAC when the diagnosis of APAP toxicity is uncertain.

Conclusion: CK/AST and CK/ALT ratios are significantly larger in rhabdomyolysis when compared to patients with APAP toxicity.

10. A Prospective, Single-Arm Trial of a 48 h IV Acetylcysteine Protocol for Treatment of Acetaminophen Overdose

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Background: In 1991, Smilkstein et al. reported 179 acetaminophen overdose patients treated using a 48 h IV acetylcysteine protocol. This study was continued but the results of the remaining 133 cases were not reported. The purpose of this report is to describe the overall findings of this study.

Methods: This is an IRB-approved, multicenter single-arm open-labeled trial including patients with a toxic concentration who presented within 24 h of an acute acetaminophen overdose.

Intervention: The intervention given was an intravenous acetylcysteine of 140 mg/kg loading dose then 12×70 mg/kg q 4 h.

Outcome: Proportion of subjects developed hepatotoxicity (ALT >1,000 u/L). Patients were stratified by time to ingestion (<10 h or >10 h) and by serum concentration (4 h lines starting at 150, 200 and 300 mg/L). Adverse events were recorded.
Results: Four hundred eight subjects were enrolled and 312 subjects met criteria for analysis. Most (68 %) were women with a mean (SD) age of 21.8 (10.0) years. The acetaminophen concentration strata were 150–200 mg/L in 60 (19 %), 201–300 mg/L in 94 (30 %), and >300 mg/L in 158 (51 %), 126 (40 %) were treated within 10 h of ingestion. The proportion of subjects who developed hepatotoxicity stratified by time to treatment and initial concentrations is shown in the table. Adverse effects (measured in all 408 treated subjects) occurred in 118 subjects and included vomiting (n=38), rash (n=30), flushing (n=27), nausea (n=23), pruritus (n=16), urticaria (n=12), and bronchospasm (n=4).
Discussion: For patients treated within 10 h, the rate of hepatotoxicity in this study is similar to the rate for patients treated with the 72-h oral protocol (6 %) and slightly higher than the rates reported for the 21-h IV protocol (0 to 4 %). Rates were also similar for those treated >10 h after ingestion (25 vs 26 % oral and 8–53 % IV). Adverse events were uncommon not serious.
Conclusions: The 48-h acetylcysteine protocol produces results similar to other protocols.

Table (Heard Abstract): Number of patients (%, 95 % CI) who develop ALT and/or AST >1000 U/L for each risk strata

[APAP] strata	<10 h to treatment	
150–200 mg/L	2 (6 %, 1–20 %)	1 (3 %, 0–16 %)
201–300 mg/L	3 (7 %, 2–19 %)	9 (21 %, 12–36 %)
>300 mg/L	5 (10 %, 4–22 %)	37 (34 %, 26–43 %)

11. Billing and Reimbursement Records for a Bedside Toxicology Consult Service at a Tertiary Care Academic Center During Fiscal Year 2011–2012

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Background: A previous article by Leikin, et al., in 2006 describes the reimbursement profile of a private toxicology practice, otherwise very little has been published regarding billing or reimbursement for toxicology consultation-based practices.
Purpose: The purpose of this study was to describe the billing and reimbursement profile for the consultation-based toxicology practice of a full-time solo-physician toxicologist in a tertiary-care academic center in the North East.
Methods: A review of consultation service billing records from July 1, 2011–June 31, 2012 (fiscal year (FY) 2011–2012). Average monthly charges, net revenue on those charges, consult numbers and payer breakdown are reviewed.
Results: There was $525,763 in overall charges generated through toxicology consultations in FY 11–12 ($389,048 inpatient $136,715 ED/outpatient). Monthly charge average was $43,814 ($32,421 inpatient $11,393 outpatient). FY 11–12 net revenue was 30 % of overall charges at $156,997 (inpatient $136,715 (35 % charges) and ED/outpatient $37,674 (28 % charges)). FY 11–12 net collection rate was 82.6 %. Charges and revenue were generated from 1,198 total consultations (967 inpatient 231 ED/outpatient). FY 11–12 average monthly consults included 81 inpatient and 19 ED/Outpatient. Blue Choice was the most common payer overall (23.97 % inpatient 27.15 % outpatient) followed by Blue Shield (18.16 % inpatient 20.56 % outpatient). Medicaid and Medicare, respectively, represented 14.56 and 8.86 % of inpatient and 11.48 and 5.89 % of outpatient charges.
Discussion: Recent discussion at the American College of Medical Toxicology Fellows-in-Training (FIT) Roundtable Discussion during the 2012 North American Congress of Clinical Toxicology indicated significant interest among Medical Toxicology trainees in developing or entering into a consultation-based toxicology practice upon completion of fellowship training. Despite this, very few current toxicologists' practices are supported from revenue generated by consultations.
Conclusion: Additional information regarding toxicology practice characteristics, in particular the economic infrastructure including billing and reimbursement rates is essential for the further development of toxicology as a feasible clinical practice.

12. Medical Toxicology Fellowship Program Trends: 2001–2012

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Introduction: Medical Toxicology (MT) and Pediatric Emergency Medicine (PEM) were two of the initial ACGME-approved fellowship training programs (FTP) that targeted emergency medicine (EM) graduates. More recently, FTPs in emergency ultrasound (EU), EMS, and critical care/emergency medicine (CC) have been created. The growth of these FTPs has resulted in increased training opportunities for EM residents. Our purpose was to assess the stability of the number of MT programs as these other FTPs expand.
Methods: We searched the online database of ACGME for the number of MT fellowship positions from 2001 to 2012. We also searched the SAEM website to determine the number of other fellowship training programs for EM residents many of which have not yet been ACGME approved.
Results: Since 2001, the number of MT programs increased from 20 to 29. During this time, 3 closed and 12 opened. From 2001 to 2003, the number of MT fellows ranged from 34 to 46. From 2004 to 2012, there were ≥50 fellows annually. In 2011, the 29 MT programs offered 104 positions of which 58 were filled (56 %). Of the 29 programs, four have no fellows, six have 25–33 % positions filled, seven have 50–67 % positions filled, and nine have 100 % or more positions filled. In 2012, there were 58 ACGME approved fellowships in PEM, 58 fellowships in EU, 60 fellowships in EMS, and 11 fellowships in CC.
Discussion: The number of MT fellows has grown since 2001 and in recent years the number has remained stable. This suggests that the trainees entering other specialty programs are not negatively impacting MT programs. This may represent an expansion of the number of EM graduates seeking FT. The future impact on MT of the growth of these other subspecialties is uncertain.
Conclusion: The number of MT fellows has remained steady despite other training opportunities.

13. Telemetry Monitoring in Pediatric Ingestions

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Background: Approximately 40,000 patients <19 years old are admitted to hospitals annually because of poisoning. There are no guidelines on which pediatric patients need to have telemetric monitoring.
Purpose: The purpose of this study was to examine the number of events captured by telemetry in children and adolescents admitted following an ingestion.
Methods: This is a retrospective chart review of patients admitted for ingestion to a telemetry unit of a children's hospital from February 1, 2010 to January 3, 2012. Cases were searched with an admission diagnosis of ingestion, overdose, or poisoning to our single ward with telemetry. Length of stay (LOS) was also recorded.

Results: One hundred sixty-four cases were admitted for telemetry over the study period. There were 36 events noted to be abnormal, 1 of which required intervention. This patient had an unconfirmed possible three-beat run of ventricular tachycardia and was kept an additional day for observation. One patient was transferred to the ICU for respiratory depression after overdose of an opiate. Twenty-two patients had either a tachyarrhythmia or bradyarrhythmia. No cardiology note was available for 22 charts. Of those, the discharge summary indicated that cardiology reviewed telemetry and there were no events for three patients (LOS 1.3 days, SD 0.58), 13 had no events but did not mention if cardiology reviewed telemetry (LOS 0.92, SD 0.27), 6 did not specifically mention that there were no events (LOS 0.67, SD 0.51. 129 (78.7 %) had EKGs prior to admission and 38 (29.4 %) had a QT >440 ms.
Discussion: Only two adverse events requiring intervention were recorded. One was picked up by pulse oximetry monitoring. The other event was unconfirmed and only required additional observation. The majority of events would have been noted by routine cardiorespiratory monitoring.
Conclusion: Few events were captured by telemetry in pediatric patients admitted for ingestions.

14. Clinical Outcomes Associated with Sumatriptan Ingestions in the Pediatric Population: A Retrospective Review of National Poison Center Data

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Background: Sumatriptan is a serotonin receptor (5-HT1B and 5-HT1D) agonist and vasoconstrictor that abates migraine headaches. Specialists at U.S. Poison Centers are making clinical judgments regarding pediatric oral sumatriptan ingestions based on very limited data. As the potential complications of any vasoconstrictor may be quite serious, this lack of data presents a unique challenge for those who manage these exposures.
Purpose: The purpose of this study was to determine the incidence and types of adverse effects associated with oral sumatriptan in children based on milligram per kilogram exposures.
Methods: This is a retrospective review of oral sumatriptan ingestions in children less than 6 years old as reported to the National Poison Data System (NPDS) from the year 2000 through 2010. All cases were followed to a known outcome. Data was categorized based on the certainty of the reported quantity ingested and the severity of clinical outcomes experienced.
Results: Out of the 781 total exposures, no major outcomes were reported. There were 427 exclusions due to lack of weight and/or quantity. Of the 354 that met the inclusion criteria, 319 (90.1 %) children experienced no symptoms and 34 ingestions (9.6 %) resulted in minor effects, at average doses of 5.69 and 8.48 mg/kg, respectively. One out of 354 children experienced a moderate effect after ingesting a maximum dose of 25.16 mg/kg.
Discussion: Exposures were mostly benign, resulting in no major effects and only one moderate effect (hallucinations/delusions). The most common minor symptoms experienced were vomiting, agitation, and drowsiness.
Conclusion: In pediatric oral sumatriptan exposures reported to NPDS between 2000 and 2010, doses up to 5.69 mg/kg resulted in no clinical effects. Although oral sumatriptan exposures in children appear to be benign, more studies are needed to determine a specific pediatric toxic dose.

15. Facebook® Rivals Traditional Methods for Plant Identification in Medical Toxicology Consultation

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Background: Plant identification often impacts clinical decision making after reported exposure. Crowd-sourced social media, such as Facebook®, are not typically utilized for real-time identification when a plant specimen is available.
Hypothesis: Crowd-sourced social media websites may facilitate timely identification of unknown plant specimens.
Methods: This is a single-patient case report. A 33-month-old female ingested an unknown quantity of unknown "red berries" and presented to the Emergency Department, with a specimen of the plant. Plant identification was sought by simultaneously forwarding bedside photographs to the Poison Control Center, the State University Herbarium, and by posting them on Facebook®.
Results: After 22 min, the Poison Control Center Specialist offered a genus of Solanum, but was unable to further speciate. The genus Solanum includes both harmless and lethal plants. Also at 22 min, the State University Herbarium curator similarly offered the genus Solanum, but cited a lack of size reference as a limit to further interpretation. The Facebook® response was both timely and accurate.The first response, from Norway, occurred within 4 min. At 26 min (4 min after other resources), a specific identification of *Solanum dulcamara* was proposed, which was subsequently echoed by two additional respondees over four more hours. Images from Google® were compared to our specimen photos, with a very strong semblance. The likely identification of the specimen impacted the toxicologist's recommendation. A definitive identification of *Solanum dulcamara* was made in 6 days by sending the specimen to the Herbarium curator.
Discussion: Crowd-sourced social media offers a new resource for international and widespread input, using digital photographs for plant identification.
Conclusion: Crowd-sourced social media websites should be investigated as a resource for timely and accurate identification of unknown plant specimens in medical toxicology consultation.

16. Acute Aspirin Overdose Managed with Sodium Acetate Due to Sodium Bicarbonate Shortage

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Background: Traditional treatment modalities for moderate aspirin overdose include urinary alkalinization to enhance salicylic acid excretion. This is traditionally performed by sodium bicarbonate administration. In recent months, sodium bicarbonate has been on shortage and some hospitals have run out of it entirely, resulting in reliance on medication substitutions for treatment.
Research question: Is urine alkalinization by sodium acetate an acceptable treatment modality for patients presenting with acute aspirin overdose when sodium bicarbonate is unavailable?
Methods: This is a case report of a patient presenting with aspirin overdose to a health care facility where sodium bicarbonate was unavailable due to shortage. Data was collected through the Georgia Poison Center.
Results: A 26-year-old male presented to the Emergency Department after an unknown ingestion. Serum aspirin levels were sent due to concern for overdose resulted in a level of 57 mg/dl. The Georgia Poison Center was contacted for management recommendations and notified that sodium bicarbonate was unavailable at the healthcare facility due to shortage. A 150-meq/L sodium acetate infusion was recommended which contained the same anion concentration as found in the traditional protocol. No initial bolus was performed. Labs were collected q2h including VBG, electrolytes, ASA level, and urine ph. Serum and urine were alkalinized without incident. The patient had an uncomplicated hospital course. Acetate infusion was discontinued on hospital day2 when serum ASA levels fell to 19 mg/dl.
Discussion: This is a case report of urine alkalinization by sodium acetate for ASA overdose when sodium bicarbonate was unavailable due to shortage. The patient suffered no side effects from

this medication which successfully caused both serum and urine alkalinization.
Conclusion: Sodium acetate is an acceptable alternative to sodium bicarbonate in urinary alkalinization in aspirin overdose when sodium bicarbonate is unavailable.

17. A Case of Four Ciguatoxin-Poisoned Patients

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Background: Ciguatera is a seafood borne illness found primarily in warmer climates. It is caused by consumption of fish containing ciguatoxin formed by the dinoflagillate *Gambierdiscus* spp. After ingestion, patients may suffer symptoms from minor GI upset to severe illness with sometimes permanent neurologic sequelae.
Purpose: Here, we present four patients with diverse presentations and clinical outcomes after ingestion of ciguatoxin containing barracuda.
Methods: This is a consecutive-patient case series. Data was obtained through the Georgia Poison Center with help from the Florida Poison Information Center, CDC and U.S. Food and Drug Administration.
Results: Within an hour of ingesting barracuda caught off the coast of Miami, four patients developed gastrointestinal symptoms of varying severity. Among the four patients, two had benign clinical courses and were discharged from the hospital after aggressive fluid resuscitation, while the remaining two had more complicated courses requiring repeated hospitalization. One patient developed atrial fibrillation and syncope, a previously unreported finding. The remaining patient developed severe illness, altered mental status and was intubated for airway protection. A protracted hospital course followed which included hemorrhagic stroke, aspiration pneumonia and tracheostomy placement. The barracuda was obtained and tested through U.S. Food and Drug Administration Chemical Hazards Science Branch which demonstrated that Caribbean ciguatoxin-1 (C-CTX-1) and 2 (C-CTX-2) were present in levels 35 times higher than the 0.1 ppb FDA guidance level.
Discussion: This case series demonstrates a highly variable clinical course of four patients that developed ciguatera intoxication after ingesting barracuda that contained both C-CTX-1 and C-CTX-2. This series includes a previously unreported finding of atrial fibrillation as well a description of the prolonged clinical course of a patient that required intubation associated with dehydration and altered mental status.
Conclusion: This case series highlights of potential health risks and various clinical outcomes of patients presenting with ciguatoxin poisoning.

18. Urine Ricinine Levels Following Potentially Fatal Castor Bean Ingestions Do Not Correlate with Clinical Outcomes

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Background: *Ricinus communis* toxicity is mediated by the toxalbumin ricin, through ribosomal and protein synthesis inhibition. Morbidity and mortality after ingestion depends on release of the toxin via disruption of the castor bean seed coat, often via mastication or maceration. Due to ricin's rapid metabolism, ricinine (3-cyano-4-methoxy-*N*-methyl-2-pyridone) is often used as a surrogate marker of exposure.
Hypothesis: Ricin toxicity is not predicted by number of beans ingested or by ricinine levels.
Methods: This is a chart review of two patients who self-reported castor bean ingestion in suicide attempts. Patient 1 ingested 30 minced castor beans; 6 h post-ingestion, he developed nausea with two episodes of vomiting. In the ED, decontamination was started with activated charcoal (AC) and whole bowel irrigation (WBI). The patient did not demonstrate any further clinical signs of toxicity. Patient 2 reported ingesting 20–30 beans after grinding them into a fine powder, then mixing and heating in his oatmeal. In the ED, decontamination was initiated with AC and WBI, and the patient suffered only mild GI upset. Serial urine samples were collected from both patients and analyzed using liquid chromatography tandem mass spectrometry (LC/MS/MS). The reported ricinine values are corrected for creatinine level.
Results: Ricinine levels are reported in Table I.
Discussion: The lethal dose of ingested ricin has been estimated at 1–20 mg/kg of ricin, roughly eight castor beans. We present two cases of large volume castor bean ingestions with the highest ricinine levels reported in the literature. Both patients experienced mild GI upset, but were otherwise devoid of any severe signs of toxicity.
Conclusion: Ricin toxicity cannot be predicted by number of castor beans ingested. Although the presence of ricinine confirms ricin exposure, it does not correlate with clinical toxicity.

Table (Carey Abstract): Urine ricinine levels following castor bean ingestion

Time post-ingestion (h)	Ricinine (mcg/L)	Creatinine-Corrected Ricinine (mcg/G-cr)
Patient 1		
26	1,325	3,745
43	605	4,090
60.5	279	1,720
66.5	214	2,490
Patient 2		
3.5	2,920	24,746
17.5	8,540	17,941
41	4,280	6,294
52	4,000	2,815
64.25	4,135	1,744
77	5,580	2,899
85.5	4,140	3,441
100.5	2,040	1,348
111.75	1,600	1,101
121	664	1,366
140	565	1,293
143	263	1,241
158	798	699
172	384	400
183	336	227

19. On the Sophistication of Tweets about Heroin, Cocaine, or Marijuana

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Background: Characterizing new and emerging drugs can be difficult, because information about those drugs is often unavailable through traditional means such as national surveys. Social networks like Twitter have been shown to contain messages from recreational drug users, and

might provide a source of information to characterize newer drugs. As a first step, we sought to correlate Twitter message complexity with previously described data on the educational background of US drug users.
Research question: Do the textual complexity of tweets discussing cocaine, marijuana, or heroin vary?
Methods: We queried Twitter for any messages within the USA over 2 months that mentioned the words 'heroin', 'cocaine', or 'marijuana', or a list of established synonyms for those drugs. We applied two measures of textual intricacy—Flesch-Kincaid gradelevel (FK) and Lempel-Ziv complexity (LZ)—to those tweets. FK measures the difficulty of a passage and corresponds to grade level in American schools. LZ measures lexicon diversity and ranges from 1 (no repeated words) to 0 (no word diversity).
Results: We found the Flesch-Kincaid grade levels were 3.18, 5.2, and 7.03 for heroin, cocaine, and marijuana, respectively. Similarly, the LZ levels were 0.91, 0.70, and 0.54. For comparison, we found the FK grade levels and LZ levels for tweets about coffee to be 8.38 and 0.63, and for beer to be 8.28 and 0.582.
Discussion: Our results suggest that tweets about illicit drugs are simpler than tweets about other substances like coffee and beer. Marijuana tweets showed a higher grade level but lower lexical diversity than tweets about cocaine, which in turn were more sophisticated but less diverse than heroin. Lexical diversity data correlates better with existing surveys on illicit drug users' age and education. Applying textual analysis tools to tweets may be useful for the toxicovigilance of emerging drugs of abuse.

20. Laundry Detergent Colitis

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Background: Colitis has been shown to occur following rectal administration of laundry detergent enemas. Although caustic injury of the pharynx and esophagus has been observed following oral ingestions, laundry detergents have not been previously documented as causing colitis following oral ingestion.
Hypothesis: Oral ingestion of laundry detergent can cause colitis.
Methods: This is a single-patient chart review. A 71-year-old woman with a history of anxiety was witnessed ingesting an unknown amount of liquid laundry detergent (All® brand) in a suicide attempt. The patient was afebrile, tachycardic, and had active emesis. She appeared uncomfortable and complained of abdominal pain, nausea, mouth and throat pain. The patient had diffuse abdominal tenderness without peritoneal signs. Her physical exam was otherwise unremarkable. The patient developed foamy diarrhea. A CT scan of the patient's chest, abdomen, and pelvis revealed diffuse colonic mucosal hyperenhancement and mild wall thickening compatible with pan-colitis. They were no injuries identified on esophagogastroduodenoscopy. Initial therapy involved anti-emetics, proton-pump inhibitor, and fluid resuscitation. By hospital day 2, the patient's abdominal pain and leukocytosis resolved. Her diet was slowly advanced. The patient was discharged to a psychiatric facility on hospital day 5 without complications.
Results: Lab work revealed a leukocytosis of 17×10^9/L [3.8–10.6] and an anion gap of 24. Her urine drugs of abuse screen was negative. Her venous blood gas measured pH 7.43, HCO_3 23 meq/L, with a base deficit of 0 meq/L. Her lactate measured 1.7 mMol/L [0.5–2.2].
Discussion: Recognized as a complication of detergent enemas, colitis is not a previously reported consequence of oral ingestion. Pan-colitis should be considered when patients present with abdominal pain following oral ingestion of detergents. Patients can be treated with supportive care.
Conclusion: We report the first case of colitis due to the ingestion of laundry detergent.

21. Methemoglobinemia in a Child with Short Gut Syndrome and Bacterial Overgrowth

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Background: Methemoglobinemia is commonly caused by ingestion of drugs or other oxidizing xenobiotics, such as nitrates. Case reports have described significant methemoglobinemia in the context of acute diarrheal illness and dehydration but usually in infants, the effects of methemoglobin levels above 70 % in this scenario have not been previously described.
Hypothesis: Life-threatening methemoglobinemia may be caused by bacterial overgrowth in susceptible children.
Methods: This is a single-patient chart review. A 29-month-old girl with "short gut syndrome" secondary to gastroschisis and subsequent recurrent *Clostridium difficile* bacterial overgrowth presented to a local hospital after being found gray and unresponsive by family. She received total parenteral nutrition and her medications included oral vancomycin and intravenous famotidine. At the receiving institution, her vital signs were: blood pressure 82/40 mmHg, heart rate 170 bpm, respiratory rate 50, and pulse oximeter 77 % on 15-L non-rebreather, Hemoglobin measured 7.8 g/dL, and methemoglobin 72.7 %. She was administered 2 mg/kg methylene blue, 15 mL/kg packed red blood cells, normal saline, and antibiotics. She was transferred to a tertiary care children's hospital where she made a full recovery. Repeat methemoglobin level was 2 %. A urine gas chromatography/mass spectrometry qualitative drug screen detected no other xenobiotics. Her home drinking water tested negative for all nitrates.
Discussion: Existing reports describe diarrhea-associated methemoglobinemia in infants under 6 months up to 57 %. No other substances were found to be responsible for this profound methemoglobinemia including medications and nitrates in her drinking water. Oxidative stress from gastroenteritis or other infections may cause methemoglobinemia in infants due to low cytochrome-b5 reductase activity and/or concentrations.
Conclusion: Life-threatening methemoglobinemia may be caused by bacterial overgrowth in children with short gut syndrome.

22. Serotonin Syndrome Secondary to Sublingual Saphris

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Background: Asenapine (Saphris®) is a new FDA-approved sublingually administered atypical antipsychotic. Case reports involving overdose of asenapine are few with the highest dose of 400 mg reported by the manufacturer to cause agitation and confusion. We present a case of sublingual asenapine overdose that resulted in serotonin syndrome.
Case Report: A 36-year-old female presented to the Emergency Department, stating that she had taken 20 of her own 10-mg tablets of asenapine sublingually 5.5 h prior to arrival. Due to somnolence, no charcoal decontamination was provided. Her vital signs were: HR 120 bpm, BP 120/78 mmHg, RR 16/min, PaO2 99 % RA, temperature 98.3 °F. The EKG demonstrated QRS=82 ms and QTc=443 ms. Physical exam revealed 3+ reflexes, tremulousness, and lower extremity rigidity without diaphoresis. The assays for aspirin, acetaminophen, ethanol and drugs of abuse returned negative, with normal CBC and CK levels. The BMP was normal except K=3.2. She received oral lorazepam 2 mg every 8 h for 2 days. She did not develop hyperthermia and her symptoms resolved within 24 h. The serum concentration of asenapine drawn at presentation was 42 ng/mL. The therapeutic limit is 1 ng/mL.

Case Discussion: Asenapine is dosed at 5–10 mg sublingually twice daily with a maximum of 20 mg per day. The bioavailability of therapeutic doses is 35 and <2 % when taken orally. The peak absorption is 0.5 to 1.5 h with an elimination half-life of 24 h when administered sublingually. As an antipsychotic, asenapine may cause CNS depression, hypotension, prolonged QT intervals and neuroleptic malignant syndrome.
Conclusion: Atypical anti-psychotics have been touted to be safer to use in patients requiring dopamine antagonism, but through their partial agonism of serotonin (5HT1A) receptors, complications arise in both overdose and in coadministration with other serotonergic agents. An acute overdose of 200 mg of sublingual asenapine produced moderate serotonin syndrome.

23. Continuous Octreotide Infusion Effectively Prevents Hypoglycemia in Resistant Pediatric Sulfonylurea Toxicity

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Background: Octreotide is a commonly employed therapy for sulfonylurea toxicity. Recommended doses range from 25–100 mcg q6–q8 h for adults and 1–1.5 mcg/kg SQ q6h for children. Despite these doses, dextrose infusions are often required and recurrent hypoglycemia is common.
Hypothesis: Octreotide is underdosed in the setting of sulfonylurea toxicity resulting in unnecessary hypoglycemic events. A continuous infusion is a safe and efficacious alternative that prevents the need for dextrose infusions and recurrent hypoglycemia.
Methods: This is a single case report.
Results: A 23-month-old girl was given approximately 35 mg of her grandmother's glyburide by her older sister and presented lethargic with a capillary glucose of 36 mg/dL. She was given 48 mL 10 % dextrose bolus and started on a D10 NS infusion at 35 mL/h. The patient had recurrent hypoglycemia (<60 mg/dL), despite administration of 1 mcg/kg SQ octreotide. An octreotide infusion was started at 5 mcg/kg/h, however, episodic hypoglycemia persisted and the dose was titrated to 10 mcg/kg/h over 5 h. After 11 h, the octreotide and dextrose infusions were discontinued and she was monitored for 24 h longer, with no further hypoglycemic events
Discussion: This patient was administered larger doses of octreotide than is currently recommended for sulfonylurea toxicity. Pediatric octreotide doses for gastrointestinal bleeding and secretory diarrhea are as high as 2 mcg/kg/h, such doses have an excellent safety profile. An octreotide infusion may be required if recurrent hypoglycemia occurs in sulfonylurea toxicity in order to avoid insulin release stimulated by high concentration dextrose drips.
Conclusion: Octreotide infusion is safe and effective in treating refractory sulfonylurea-induced hypoglycemia.

Table (Escajeda Absract): Serum glucose and infusion rates

Time	Glucose (mg/dL)	D10 Normal saline rate (mL/h)	Octreotide (mcg/kg/h)
0630	59	0	0
0745	36	0	0
0815	103	25	0
1000	68	35	5
1100	58	35	8
1345	128	35	10
1900	167	5	10
2000	85	0	10
2315	121	0	0

24. First Reported Case of Fentanyl-Associated Hearing Loss

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Background: Opioid-associated hearing loss (OAHL) has been described with the abuse of a number of opioids including morphine, codeine, heroin, oxycodone, hydrocodone, oxymorphone, methadone, and propoxyphene, but not fentanyl.
Hypothesis: Acute sensorineural hearing loss is a consequence of fentanyl abuse.
Methods: This is a single-patient chart review. A 22-year-old man was brought to an outside hospital complaining of difficulty hearing and inability to ambulate. The night prior to presentation, the patient reportedly drank four beers, cut an unused 100 mcg fentanyl patch in quarters, placed one quarter in his mouth, chewed, and swallowed. He subsequently lost consciousness. He reported severe hypoacusis, tinnitus, and inability to move his legs upon awaking the next morning. At an outside hospital, he had demonstrable bilateral lower extremity weakness (4/5) that resolved after transfer to the tertiary care facility. His only remaining complaint following transfer was hearing loss. Audiometry obtained 2 days after fentanyl ingestion demonstrated a mild high-frequency sensorineural hearing loss bilaterally. Complete subjective resolution of his hypoacusis and tinnitus occurred on hospital day (HD) three. Lab work including creatinine, electrolytes, and CPK normalized and he was discharged home on HD seven.
Results: Vital signs were normal. Initial laboratories revealed creatinine 2.7 mg/dL (0.5–1.4 mg/dL), BUN 28 mg/dL (8–26 mg/dL), potassium 8 mmol/L (3.5–5 mmol/L), and CPK 12,000 IU/L (<200 IU/L). Serum salicylates, acetaminophen, and toxic alcohols were undetectable. Urine gas chromatography/mass spectrometry (GC/MS) was positive for caffeine, nicotine, and fentanyl.
Discussion: This case represents the first report of fentanyl-associated hearing loss. The history and audiometry are consistent with previous reports of OAHL. There were no other ototoxic substances on GC/MS or by history.
Conclusion: Acute sensorineural hearing loss may be associated with abuse of fentanyl.

25. Persistent Hypertension with Bradycardia after Clonidine Patch Ingestion in a Toddler

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Background: Clonidine overdose is classically characterized by initial hypertension due to peripheral alpha-2 agonism followed by hypotension and bradycardia due to central alpha-2 agonism.
Hypothesis: We hypothesize that persistent hypertension with bradycardia can be an atypical manifestation of acute clonidine overdose.
Methods: This is a single-patient chart review. A 14-month-old male presented with a history of persistent somnolence after going down for his nap 7 h prior. There was no history of ingestion but the father was prescribed a clonidine patch. Throughout the following 36 h, the patient remained very somnolent and was persistently bradycardic and hypertensive, with numerous systolic blood pressures (SBP) recorded near or above the upper limit of normal for that age. Heart rate reached a nadir of 61 beats/min at which time SBP was 113 mmHg. Two milligrams of naloxone was administered which elicited a delayed and transient response during which, 10 min after administration, the patient woke up and cried for 2–3 min and heart rate increased to 110 beats/min, followed by a rapid return to somnolence and bradycardia.
Results: A rapidly obtained comprehensive drug panel was positive for clonidine, at which point activated charcoal was administered and

whole bowel irrigation was performed with polyethylene glycol via nasogastric tube. A clonidine patch was recovered in the stool on hospital day2 and symptoms began to resolve about 36 h after presentation.
Discussion: This is an atypical presentation of confirmed clonidine ingestion in a 14 month old characterized by hypertension and bradycardia. The physiological mechanism of these findings is unclear, but it is possible that prolonged absorption of relatively low amounts of clonidine from the gut produced persistent peripheral alpha-2 agonism without significant central sympatholytic effects.
Conclusion: CNS depression with persistent hypertension and bradycardia is a potential presentation of clonidine toxicity in a child.

26. Efficacy and Safety of Physostigmine for Anti-cholinergic Delirium from Psychotropic Drugs

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Background: Physostigmine has been shown to be effective in managing delirium from anti-cholinergic poisoning. While this has been accepted for pure anti-muscarinic drugs, psychotropics with multiple mechanisms of action such as cyclic anti-depressants and anti-psychotics also cause delirium from muscarinic blockade. Physostigmine use in this setting has been cautious or avoided by clinicians due to concerns of cardiac toxicity since a cardinal report in 1980.
Hypothesis: Physostigmine is an effective and safe antidote for anti-cholinergic delirium from psychotropic drugs.
Methods: Literature search in was done Medline, PubMed, Google Scholar and Embase since 1980, using search terms "physostigmine" AND "reversal" or "delirium". Case reports or series describing the use of physostigmine for the management of acute delirium from drug overdose were selected. Review, non-human and non-English language articles were excluded, as well as reports involving pure anti-cholinergic poisoning was also made.
Results: Since 1980, 117 cases of physostigmine use in non-pure anti-muscarinic poisoning complicated by delirium have been published. The drugs implicated were anti-psychotics, anti-depressants, anti-histamines, anesthetic agents, opiates, and GABA-ergics. There were also 44 cases where the drug involved was unknown and physostigmine was used as a diagnostic agent.
Discussion: The caution against physostigmine in psychotropic-induced anti-cholinergic delirium is based on a few case reports. Physostigmine appears to be most effective when treating delirium from drugs known to block central muscarinic receptors. Other than failure of resolution of delirium, few adverse events have been reported from physostigmine use in delirium.
Conclusion: Physostigmine is likely to be most effective in managing delirium from central muscarinic receptor blockers, and appears safe when administered outside the period of cardiac toxicity from psychotropics. Its efficacy in delirium caused by non-muscarinic receptor blockers, delirium of unknown cause, or in post-anesthetic delirium remains doubtful.

27. Utility of Liver Dialysis Therapy in Drug-Induced Hepatotoxicity

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Background: Management of acute liver failure (ALF) due to drug-induced hepatotoxicity traditionally involves intensive supportive care and the use of *N*-acetyl-cysteine (NAC). The Molecular Adsorbent Recirculating System (MARS) albumin dialysis is an emerging therapy for drug-induced hepatotoxicity.
Aim: The aim of this study was to assess the safety and efficacy of MARS in the treatment of ALF due to drug-induced hepatotoxicity, as a bridge to native hepatic recovery.
Methods: This is a retrospective case series. Three patients with drug-associated ALF (two acetaminophen and one possible clarithromycin) who presented greater than 24 h after the onset of hepatic encephalopathy are discussed. ALF was defined as the presence of hepatic encephalopathy and INR greater than 1.5. All patients were not candidates for liver transplantation due to underlying psychiatric disorders. In addition to NAC therapy, all patients underwent 8 h sessions with the MARS hemofiltration system on three consecutive days. AST, ALT, INR, total bilirubin, pH, ammonia, and hepatic encephalopathy scores were recorded prior to treatment, after each session and after protocol completion. Treatment was completed using simultaneous albumin dialysis and renal replacement therapy with citrate anticoagulation.
Results: All three patients presented with hyperammonemia (range 63–114), and coagulopathy (INR range 1.74–4.1). After MARS treatment, all patients had improvement of hyperammonemia (range 36–56), improvement in presenting encephalopathy and a resolution of coagulopathy. No complications from MARS therapy were noted. All three patients survived to discharge with clinical and biochemical improvement.
Discussion: These three cases demonstrate the safety and potential efficacy of liver dialysis in ALF due to drug-induced hepatotoxicity. Prospective randomized controlled studies are needed to further examine the efficacy of MARS in ALF.
Conclusion: Liver dialysis is a promising therapy in the treatment of ALF due to drug-induced hepatotoxicity, and may reduce mortality and the need for liver transplantation by facilitating native hepatic recovery.

Table (Halliday Abstract): INR results

Patient	Admission (INR)	Day 1 post-treatment	Day 2 post-treatment	Day 3 post-treatment	Day 4
Patient A	1.74	1.47	1.67	1.66	1.40
Patient B	4.1	2.41	1.83	1.41	1.44
Patient C	2.19	1.64	1.33	1.2	1.13

28. Guanfacine Extended-Release Ingestion with Delayed Hypotension

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Background: An extended-release (ER) oral formulation of guanfacine hydrochloride has been approved by the FDA for the treatment of attention-deficit/hyperactivity disorder (ADHD) in children 6–17 years old. There are few reports describing overdose of the ER formulation.
Hypothesis: We hypothesize that symptoms following guanfacine ER overdose may result in delayed hypotension.
Methods: This is a single-patient chart review. A 15-year-old male with a history of ADHD presented to the Emergency Department after taking approximately 15 of his brother's 2 mg guanfacine ER tablets in a suicide attempt. He reported taking some of the tablets approximately 36 h prior to arrival and the remainder approximately 12 h prior to arrival. He was excessively drowsy over the previous 2 days at which point he told his mother of the ingestion upon questioning. In the Emergency Department, he was sleepy but easily aroused. His exam was otherwise normal including normal vital signs. He was observed in the Emergency Department for 4 h and was subsequently transferred to the psychiatry unit. Approximately 30 h post-ingestion, the patient was noted to be difficult to arouse and hypotensive. He was subsequently transferred to the intermediate

care unit for monitoring and treatment. His blood pressure improved with intravenous fluid and was transferred to the floor after 20 h of monitoring.
Results: Blood pressures appear in the table.
Discussion: This case of acute ingestion presented with delayed onset of hypotension greater than 16 h from the time of ingestion. This suggests a prolonged period of observation is necessary post-ingestion of guanfacine ER formulation.
Conclusion: Delayed onset of hypotension may occur following guanfacine ER ingestion warranting a prolonged period of observation.

Table (Hannum Abstract): Blood pressure and heart rate measurements post-ingestion (PI) of guanfacine ER

Hours PI	**12**	**16**	**30**	**48.5**	**49.5**
Blood pressure (mmHg)	99/67	106/72	87/47	83/52	110/70
Heart rate (bpm)	72	79	79	55	65

29. Major Bleeding Events in Salicylate Toxicity

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Background: Abnormal coagulation studies are occasionally identified in the setting of salicylate overdose. It is hypothesized that this occurs via disruption of the activation of vitamin K-dependent factors. However, the risk of major bleeding events and factors associated with this complication have not been described.
Research question: In cases of salicylate toxicity, what features are associated with major bleeding events?
Methods: This is a retrospective case–control study at a tertiary care hospital in an urban setting. All cases from 2001 to 2011 with a salicylate level >30 mg/dL were reviewed for major bleeding events. Coagulopathy was defined as an INR >1.5 and major bleeding as fatal bleeding, symptomatic bleeding (intracranial, intraspinal, intraocular, retroperitoneal, pericardial, intramuscular), or bleeding with a two-point hemoglobin decline or two-unit pRBC transfusion. Univariate analysis of clinical features in cases of major bleeding compared to controls was performed. Variables with a p value ≤0.1 were included in a multivariate model.
Results: One hundred three patients had salicylate levels >30 mg/dL. Fourteen had an INR >1.5. Six patients were found to have major bleeding events (5.8 %, 95 % CI: 2.2–12.2) and three patients died. Four of the major bleeding events occurred in patients with an INR >1.5. The three deaths were not likely caused by major bleeding, but attributed to autoimmune hepatitis, polydrug overdose, and trauma. In univariate analyses, the degree of renal dysfunction and coagulopathy were significantly associated with major bleeding ($p<0.05$). In a multivariate analysis, no individual variable remained significant (see table). The multivariate model correctly classified 91.07 % of the cases, with an AUC of 0.84 and a R^2 of 0.28.
Discussion: The analysis was limited by retrospective design, restriction to a single center, and small number of major bleeding events.
Conclusion: Major bleeding events occurred in 5.8 % of patients. The degree of renal dysfunction and INR >1.5 were identified as potential predictors of major bleeding in salicylate poisoned patients.

Table (Hatten Abstract): Clinical predictors of major bleeding events

	Clinical features	**Case (6 patients)**	**Control (97 patients)**	***p* value**	**OR (95 % CI)**
Univariate	Age (mean in years)	42.05	28.64	0.08	1.03 (0.99–1.08)
	Maximum ASA (mean level in mg/dl)	58.25	53.53	0.49	1.02 (0.97–1.06)
	Duration ASA >30 (mean hours)	16.31	11.12	0.18	1.06 (0.97–1.16)
	Chronic ASA toxicity (proportion)	0.33	0.17	0.29	2.47 (0.42–14.65)
	Renal function (mean minimum GFR within 15 days)	39.48	91.15	0.01	0.94 (0.90–0.98)
	Coagulopathy (proportion with INR >1.5)	0.67	0.20	0.03	8.2 (1.31–51.26)
Multivariate	Age (mean in years)			0.72	0.99 (0.94–1.05)
	Renal function (mean minimum GFR within 15 days)			0.10	0.96 (0.91–1.01)
	Coagulopathy (proportion with INR >1.5)			0.28	3.42 (0.37–31.23)

30. Small Patients, Small Packets, Small Catastrophes: Liquid Laundry Packet Poisoning Reported to a Statewide Poison Control System

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Background: During 2012, single-use liquid laundry packets have been increasingly recognized as a pediatric hazard.
Research question: What are the toxic effects of exposure to liquid laundry packets as reported to a statewide poison control system?
Methods: This is an IRB-approved, retrospective review of the California Poison Control System electronic database. All cases of laundry detergent packet exposures during January to July 2012 were identified. Demographic and clinical data were tabulated for analysis of symptoms and outcomes.
Results: Exposure complications are summarized in Table 1. A total of 202 cases of laundry detergent packet exposures were identified after 29 were excluded for miscoding. Monthly totals increased in successive months. The median age was 2 years. Most cases (116) were managed at home. Among 86 cases resulting in healthcare facility visits, 14 children required hospital admission, with five admitted to a pediatric intensive care unit. Hospitalizations ranged 1–6 days. Gastrointestinal, respiratory, metabolic, and neurologic effects were prominent. Endotracheal intubation was required in one case. Two brand name products were disproportionately responsible for the moderate and severe effects.
Discussion: Laundry packet ingestions represent an important new pediatric ingestion hazard with the potential for gastrointestinal, neurologic, metabolic, and ocular effects. More studies are needed to explain the toxic mechanisms of these products, and to identify strategies to treat exposure complications. Study limitations include selection bias and inadequate follow-up in some cases.
Conclusion: Clinicians should be aware that while most liquid laundry detergent exposures cause minor effects, they occasionally result in severe toxicity. Surveillance, prevention, and parental education efforts should focus on these new hazards.

Table (Heppner Abstract): Adverse effects of laundry packet ingestion (n=204 cases)

Effect	**Total cases**	**Percent**
No effect	49	24
Vomiting	133	66

Respiratory effects	33	16
Depressed mentation	19	9
Metabolic disturbances (acidosis, hyperglycemia)	7	3
Ocular injury	17	8
Dermal irritation	1	0.5

31. Theophylline Protein Binding at Toxic Concentrations

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Background: Extensive protein binding is considered a pharmacokinetic feature of a xenobiotic making it less amenable to hemodialysis. Theophylline is about 60 % protein bound. Decreased protein binding at increased serum theophylline levels has been reported by some investigators but not others.
Research question: The purpose of this study was to investigate the relationship of serum theophylline protein binding to concentration in an in vitro model using healthy adult male blood.
Methods: Plasma from three healthy volunteers abstinent of caffeine for 24 h was collected into heparinized tubes. Plasma was spiked with aliquots of serial dilutions of aminophylline with target theophylline concentrations of 10, 20, 40, 80 and 160 mcg/mL. Specimens were incubated in a 37 °C water bath for 30 min and then split and assayed for total and free theophylline. Repeated measures ANOVA were used to compare protein binding to theophylline concentration.
Results: Serum protein binding did not change over the concentrations investigated in this study (Table) [p=NS].
Discussion: The characteristics of a xenobiotic favorable for removal by hemodialysis include a low volume of distribution, small size and scant protein binding. Drugs effectively dialyzed despite greater protein binding include salicylate and theophylline. Unlike salicylate, where protein binding is decreased at toxic levels, these results suggest that theophylline protein binding is little changed at toxic levels. Protein binding in the range observed with theophylline may not be an impediment to hemodialysis for drugs with characteristics otherwise favorable for hemodialysis. Conversely, there may be other features unique to theophylline that allows it to be effectively removed by hemodialysis despite this degree of protein binding. This study is constrained by small sample size and its in vitro nature.
Conclusion: Theophylline protein binding is relatively constant through a wide range of concentrations.

Table (Hodgman Abstract): Serum theophylline levels

Subject	Target concentration (mcg/mL)	Total (mcg/mL)	Free (mcg/mL)	Percentage bound
A01	10	13.83	5.67	59.0
A02	20	30.05	11.39	62.66
A03	40	55.93	22.35	60.04
A04	80	113.57	45.41	60.02
A05	160	239.10	98.16	58.95
B01	10	13.81	5.96	56.84
B02	20	28.06	12.02	57.16
B03	40	61.70	28.02	54.59
B04	80	112.11	50.05	55.36
B05	160	234.55	113.41	51.65
C01	10	14.35	5.38	62.51
C02	20	27.69	11.12	59.84
C03	40	57.38	21.28	62.91
C04	80	109.29	44.38	59.39
C05	160	227.80	113.74	50.07

32. Carisoprodol Toxicity Characterized by Severe Myoclonus Without Seizure Activity

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Background: Carisoprodol is a centrally acting muscle relaxant commonly used for the treatment of musculoskeletal disorders. While seizure in carisoprodol overdose has been reported, it is uncommon. In contrast, myoclonus is reported with carisoprodol toxicity. Distinguishing the two entities at the bedside, however, can be exceedingly difficult.
Hypothesis: Severe carisoprodol-induced myoclonus may be misdiagnosed as seizure activity.
Methods: This is a single-patient chart review. A 25-year-old woman with a history of IV heroin abuse and chronic back pain presented to the Emergency Department after carisoprodol overdose. She was found sedated with empty pill bottles. Upon arrival, the patient was unresponsive, had severe vertical nystagmus, and vigorous, whole body jerking movements. She was intubated for airway protection and started on a propofol infusion. Despite this, she continued to exhibit these movements, requiring adjunctive lorazepam, midazolam, and phenobarbital.
Results: A brain CT was obtained, which was unremarkable. Serum ethanol, salicylate, TCA, and acetaminophen concentrations were unmeasureable. An EMIT urine drug screen of abuse detected opiates, benzodiazepines, and methadone. Due to concern for seizure activity, the patient was administered both levecitiram and phenytoin, and an EEG was performed, which demonstrated midline frontal spikes consistent with myoclonus and not seizure activity. A urine comprehensive drug screen (GC/MS) measured a very large peak of carisoprodol. Tremors and ocular nystagmus resolved within 24 h of the patient's ingestion, and the patient was successfully extubated. Repeat EEG showed no epileptiform discharges, and she was transferred to inpatient psychiatry.
Discussion: Carisoprodol is well-known to cause myoclonus, altered mental status and hypotension in overdose. The myoclonus may be vigorous and confused with seizures.
Conclusions: Patients who present with carisoprodol toxicity may exhibit vigorous myoclonus which may be confused with seizures. Treatment with antiepileptic medications in these instances is of no benefit and not indicated.

33. Hydrofluoric Acid Exposures That Burn the Physician

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Background: Hydrofluoric acid (HF) characteristically produces "pain out of proportion to physical findings."
Hypothesis: HF is sometimes exploited in drug-seeking behavior (DSB).
Methods: Data were obtained from medical records of eight consecutive HF exposures referred for follow-up during 2000–2011.
Results: Initial history was only from the patient. Exposures comprised six dermal and two inhalational. Six presented to the Emergency Department (ED) within 4 h. One claimed symptoms from exposure 2 months earlier. Two presented 1 day after job termination. Initial dermal exam findings ranged from none to mild erythema. Both inhalational exposures had normal lung exams and O_2 saturation. None had hypocalcemia or radiographic evidence of lung injury. Four were

reported to exhibit significant pain behavior, e.g., moaning, limping, clutching limbs, and anxiety. Seven received topical, injection, or nebulized calcium gluconate (CaGl). One received arterial CaGl followed by repeated injections at 3 months. One received nebulized CaGl at 2 months. Poison center consultation occurred in six. At follow-up, exposure data revealed no HF >10 %. Two reports were not plausible, i.e. "powdered form" or remote outdoor source. All were receiving benefits and reported pain several months after exposure. None had objective findings of injury. Two had been incarcerated for violent behavior. Five were receiving opioids from multiple prescribers. Surveillance revealed one probable diversion. Three were admitted twice for "pain control" after 2 weeks.
Discussion: DSB in the ED most commonly involves pain complaints that do not correspond with objective findings, e.g., headache or back pain. These eight cases illustrate the potential for HF to present as DSB in unconfirmed exposures to HF that present with pain but no findings of injury.
Conclusions: DSB should be considered in an unconfirmed or unlikely HF exposure when no finding of injury is observed. Early identification of DSB can avoid inappropriate antidotal and opioid administration.

34. Pediatric Sulfonylurea Ingestion: Is Home Monitoring an Option?

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Background: Pediatric sulfonylurea ingestions are often managed with mandatory referral to health care facilities (HCFs) because of the risk of delayed hypoglycemia, seizure, or coma. The Oregon Poison Center (PC) has historically managed select patients at home to reduce resource utilization.
Research question: Is monitoring select pediatric sulfonylurea ingestions at home safe?
Methods: We performed a retrospective chart review of pediatric (age <5) sulfonylurea calls from 2002 to 2011. The following parameters were abstracted: age, disposition, development of hypoglycemia (blood glucose (BG) <60 mg/dL), seizure, or coma. For home-managed patients, we also extracted: certainty of ingestion, specific agent, amount ingested, and duration of PC follow-up. We excluded cases if missing pills were found prior to disposition.
Results: Three hundred four cases met the criteria. Two hundred five (67 %) were managed at a HCF and 93(31 %) were managed at home. Six (2 %) were excluded. Forty-three (46 %) of the home-managed cases were confirmed (witnessed) exposures. 31 (72 %) ingested <1 pill, 7 (16 %) ingested single pills, and 5 (12 %) ingested >1 pill. Average age was 21.2 months, and 58 % were male. Agents ingested were as follows: glyburide, 20 (47 %), glipizide (including XL), 14 (32 %), and glimepiride, 9 (21 %). Of the 43 confirmed ingestions, 2 (5 %) developed BG< 60 mg/dL and subsequently presented to a HCF. None developed seizure or coma. The average duration of follow-up for the remaining cases was: glyburide, 5.49 h (range 0–14); glipizide, 4.33 h (range 0–9); and glimepiride, 7.44 h (range 2–17).
Discussion: We report 43 confirmed pediatric sulfonylurea ingestions managed at home. Five percent developed uncomplicated hypoglycemia (BG<60 mg/dL), and none developed seizure or coma. Our findings suggest it may be possible to monitor a select group of pediatric sulfonylurea ingestion patients at home with low risk. Further prospective studies should explore factors associated with favorable outcome. Limitations include retrospective PC data and variation in follow-up lengths.
Conclusion: In this retrospective study, home observation of a select group of pediatric sulfonylurea ingestions was associated with low risk of hypoglycemia. Further prospective studies are warranted.

35. Defibrillation as the Primary Treatment in Benzonatate Overdose

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Background: Benzonatate, Tessalon®, is a medication used as a cough suppressant since 1958. Overdoses can result in cardiac arrest and seizures.
Hypothesis: (1) Fat emulsion therapy does not offer additional benefit in the setting of acute benzonate toxicity responsive to defibrillation. (2) Polyethylene glycol contained in some benzonatate formulations may interfere with the urine drug screen.
Methods: This is a single-patient chart review. A healthy 17-year-old woman ingested twenty 100 mg benzonatate tablets in a suicide attempt. She was found unresponsive, pulseless, and in ventricular fibrillation by EMS. The patient was defibrillated at 150 J on scene with return of spontaneous circulation in sinus tachycardia. The initial urine drug screen of abuse (EMIT II Plus, Siemens) was reported as inconclusive due to an interfering substance. A urine gas chromatography/mass spectrometry qualitative drug screen demonstrated a large peak of benzonatate and polyethylene glycol. The patient was admitted to the ICU for 2 days and received supportive care. The patient had full neurologic recovery and was discharged without complications to a psychiatric facility on hospital day 3.
Discussion: Benzonatate is structurally similar to the ester class of local anesthetics for which treatment includes fat emulsion therapy. This case report details a case of benzonate ingestion resulting in ventricular fibrillation responsive to defibrillation. There does not appear to be a benefit to implementing fat emulsion therapy in patients that convert to a stable rhythm after electrical therapy. Polyethylene glycol that is used as an excipient in the benzonatate tablet may act as an interfering substance in the urine drug screen.
Conclusions: (1) Patients who respond to defibrillation in benzonatate ingestion do well with supportive therapy and have short-lived toxicity. (2) The urine drug screen in benzonate overdose may show polyethylene glycol as an interfering substance.

36. Which Psychiatric Patient Will Have an "Occult" Acute Aspirin or Acetaminophen Overdose?

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Introduction: Patients who present with acute ASA/APAP overdose and who may not offer an accurate history can be difficult to treat. We sought to determine the prevalence of and demographic characteristics of these types of patients in a cohort of subjects with a high risk of "occult" acute overdose.
Methods: We performed a retrospective chart review of all patients who presented with a primary psychiatric complaint to the psychiatric area of an academic, suburban, Emergency Department (annual census 85,000) between September 19, 2010 and September 30, 2011. At our institution, patients are routinely screened for ASA/APAP levels for appropriate psychiatric care ("medical clearance"). We defined all patients with supra-therapeutic levels as an acute overdose. We excluded subjects who presented hemodynamically unstable or admitted to overdose of ASA/APAP-containing products on presentation.
Results: Of 1,133 patients presenting to the psychiatric area of the ED in this time period: 741 received ASA/APAP screening (65.4 %). Of the 741 patients receiving ASA/APAP screening, 675 had both ASA and APAP screening (91.1 %, mean age 39.1 SD 16.4, 49.6 % male). Fifty-four had only APAP screening (7.3 %, mean age 44.6±16.0, 35.2 % male). Twelve had only ASA screening (1.6 %, mean age 36.0±12.0, 50.0 % male). One subject had an occult supra-therapeutic ASA level (70.6 μg/mL) prevalence 0.13 %. Two subjects had an occult supra-therapeutic APAP level

(35, 124 μg/mL) prevalence 0.27 %. Of the three subjects, two required immediate management changes. Although these three subjects tended to be younger (26, SD 2.0, 66 % male) as compared to their counterparts, this was not statistically significant (p=0.17).
Conclusion: A prevalence rate of 0.13 and 0.27 % for supra-therapeutic ASA/ APAP levels is consistent with prior studies describing patients who were unable to give appropriate histories and presented with occult overdoses. In this cohort, we could not determine differences in the age or gender.

37. Sudden Onset Bilateral Sensorineural Hearing Loss Following Fentanyl Overdose

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Background: Previous case reports have described the association of sudden onset sensorineural hearing loss with the abuse of opioids including heroin, methadone and hydrocodone. This phenomenon has been termed 'opioid-associated hearing loss' or OAHL.
Hypothesis: Like previously described opioids, fentanyl abuse can be associated with sudden onset bilateral sensorineural hearing loss.
Methods: This is a single-patient chart review. A 26-year-old previously healthy male who had been released from jail 5 days previously was found obtunded by his mother after he snorted three 50 μg fentanyl patches. He was given naloxone with reversal of sedation. When he awoke, he complained of difficulty hearing. Bedside testing confirmed moderate bilateral sensorineural hearing loss. The hearing loss slowly improved over time and by the time of discharge 24 h later, it had resolved completely.
Results: Urine drug screen confirmed presence of fentanyl.
Discussion: Fentanyl and other opioids are common drugs of abuse, and have many well-described side effects. Although rarely reported, these opioids have been associated with bilateral sensorineural hearing loss. The mechanism is poorly understood, but cases have included both irreversible as well as short term hearing loss with improvement over a period of days.
Conclusion: Abuse of opioids should be considered in patients presenting with abrupt onset sensorineural hearing loss.

38. A Case of Ethylene Glycol Poisoning Presenting as an ST Elevation Myocardial Infarction

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Background: Severe poisoning with ethylene glycol (EG), which is often used as antifreeze, is a life-threatening event. Neurological symptoms are accompanied by metabolic derangement and potential renal damage. This is the first reported case of an ethylene glycol overdose presenting as an apparent acute STEMI that was taken to the cath lab.
Hypothesis: EG toxicity can produce a Brugada pattern EKG that can be mistaken for STEMI.
Case Report: A 34 year-old male with no known PMH presented from prison obtunded with a GCS of 3. His initial VS were a BP of 152/77, pulse 102, temperature 35 °C, respiration rate 30, and SpO2 100 % on RA. He was intubated. It was noted that he had a widened QRS and peaked T-waves, for which he was given 2 amps of sodium bicarbonate. An EKG revealed ST elevations in V1 and V2, peaked T-waves, and QRS 116 ms. He was immediately taken to the catheterization lab, where a study revealed no coronary blockage. Meanwhile, laboratory data began to return. It included a potassium >8.5 mmol/L, bicarbonate 4 mmol/L, pH 6.9, Cr 2.71 mg/dL, ethanol <10 mg/dL, anion gap 36, osmol gap 70. The patient was taken to the MICU, where fomepizole was to be initiated. However, the patient experienced continued bradydysrrhthmias and hypotension and expired 4 h after arrival. Ultimately his EG concentration was 118 mg/dL.
Case Discussion: The metabolic derangement resulted in EKG changes that ultimately lead to cardiac catheterization instead of the definitive treatment of fomepizole and hemodialysis. In retrospect, the EKG reflected a type I Brugada pattern. This pattern was likely due to severe hyperkalemia from the ethylene glycol-induced renal failure.
Conclusion: Providers should be aware that acute hyperkalemia due to acute renal failure from EG may result in a Brugada pattern on EKG.

39. Which Laboratory Values Correlate With 5-Oxoprolinemia After Acute Paracetamol Poisoning?

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Background: A growing number of reports describe high concentrations of 5-oxoproline (5-OP), also called pyroglutamic acid, in cases of acute paracetamol poisoning with wide anion gap metabolic acidosis.
Purpose: We sought to determine which commonly available laboratory tests and calculated values correlate with [5-OP].
Methods: In this literature review, we searched MEDLINE from 1946 to present using terms ("oxoproline" OR "pyroglutamic acid") AND ("acetaminophen" OR "paracetamol"). We limited the search to human studies. We included articles published in English or foreign language articles containing laboratory information. We recorded the following values: [APAP], creatinine, serum bicarbonate, anion gap, serum pH, [AST], INR, and lactate. We used Excel (Microsoft, Redmond WA, USA) to create scatter plots and to calculate correlation coefficient (r^2), slope (m), and intercept (b).
Results: The intersection of 67,630 articles on paracetamol and 980 articles on 5-OP included 94 articles or book chapters. Eighty-six pertained to humans, 35 of these were original articles including 22 cases reporting either urine or serum 5-OP concentrations for a total of 40 patients. Values for r^2, m, and b for urine and serum 5-OP are in Table 1.
Discussion: None of the laboratory tests correlated well with the serum or urine [5-OP]. The highest observed r^2 was for INR, but this was based upon only five values. There likely was a selection bias as measurement of 5-OP is limited to patients in specialized centers when clinicians suspect its presence based upon unexplained metabolic acidosis or other factors.
Conclusion: In paracetamol-poisoned patients with elevated anion gap metabolic acidosis, none of the common laboratory tests are suitable surrogates to suggest oxoprolinemia when direct measurement of 5-OP is not available.

Table (Liss Abstract): Correlation coefficient, slope, and intercept for common laboratory values vs. urine and serum 5-oxoproline concentration.

Lab values	Urine [5-OP]			Serum [5-OP]		
	r^2	m	b	r^2	m	b
[APAP]	0.0378	−0.011	590.00	0.105	−49.1	948.00
Serum Cr	0.0157	−0.0009	198.00	0.0024	−0.648	210.00
HCO_3	0.0004	0.000005	7.32	0.003	0.0193	6.134
Anion Gap	0.0245	−0.00007	30.10	0.0186	−0.126	32.00
Serum pH	0.1370	0.000003	7.12	0.0007	0.0006	7.14

[AST]	0.0194	−0.0362	974.00	0.0164	−3.34	179.00
INR	0.0781	−0.00006	1.90	0.580	0.465	0.914
[Lactate]	0.0271	−0.00002	2.16	0.0232	−0.0713	4.00

40. Ben Tripping: A 5-Year Retrospective Review of Diphenhydramine Cases

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Background: Diphenhydramine (DPH) is a sedating antihistamine commonly used for allergies, motion sickness, and as a sleep aid. Its easy availability over the counter and its intoxicating effects make it a commonly abused and misused substance. Literature describes many cases and the effects of abuse, but there is little information on its usage patterns.
Objective: The purpose of this study was to characterize the evolving patterns of DPH exposures reported to poison centers over the last 5 years.
Methods: This is a retrospective review of the National Poison Data System (NPDS) published data over the 5 years (2006–2010) via the American Association of Poison Control Centers' Annual Report. Collected data include: total calls, age, reason for exposure, treatment location, and adverse effects. A PubMed search of "diphenhydramine" and "diphenhydramine overdose" for corresponding years was also conducted.
Results: In the last 5 years (2006–2010), total number of calls for DPH human exposures increased. The largest increase occurred in children <6 year (slope 1,260 calls/year increase), and smaller increases in those aged 6–19 years (180 calls/year increase), and >19 years (mean 189 call/yr increase). During that time, intentional use of DPH decreased while unintentional exposures increased slightly. Although deaths remained stable, major outcomes slightly increased. We analyzed numbers of PubMed articles and noted a similar change in number of publications related to DPH suggesting that this was due to a change in usage pattern.
Discussion: These results indicate that the use of DPH exposures appear to be changing, with increased exposures in children <6 years old and decreasing abuse amongst teenagers and children aged 6–19 years. Limitations include the known pitfalls of using NPDS data.
Conclusion: Calls to poison centers regarding DPH are increasing and tend to involve young children. Since 2006, there is increased number of calls and decreased in intentional use. Further monitoring of trends may help elucidate why such changes may occur.

41. Failure of Dexmedetomidine to Adequately Sedate a Patient with Anti-Muscarinic Toxicity

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Background: Sedation without intubation is made possible through use of drugs such as dexmedetomidine. Use of this central alpha-2-agonist in the post-overdose setting is not well-described.
Hypothesis: Dexmedetomidine may not adequately sedate patients suffering from anti-muscarinic toxicity.
Methods: This is a single-patient chart review. A 29-year-old woman with history of bipolar disorder presented to the Emergency Department with altered mental status after ingesting an over-the-counter liquid formulation of diphenhydramine and acetaminophen. Vital signs: 36.8 °C, HR 135 bpm, RR 18 rpm, BP 129/86 mmHg, and O_2 sat 100 % on room air. The patient was delirious with mumbling speech, picking behaviors, dry mucous membranes, and mydriasis. Physical exam was otherwise unremarkable. Her electrolytes were within normal limits. An EKG showed sinus tachycardia with QRS 80 ms and QTc 446 ms. The patient's mental status normalized upon administration of physostigmine. A urine gas chromatography/mass spectrometry qualitative drug screen demonstrated acetaminophen, diphenhydramine, and ibuprofen. Acetaminophen toxicity with a level of 161 mcg/mL was treated with 21 h IV *n*-acetylcysteine protocol. The patient became agitated and received 7 mg of intravenous lorazepam over the course of 7 h which failed to control her agitation. Therefore, dexmedetomidine infusion was initiated and also failed to sedate the patient despite rapid titration up to the maximum dose (1 mcg/kg/h). The patient was ultimately intubated and sedated with a propofol infusion. Her anti-muscarinic toxicity resolved over 48 h. The patient was extubated and transferred to a floor bed awaiting psychiatric placement.
Discussion: Despite titration to the maximum dose, dexmedetomidine failed to adequately sedate the patient. A central alpha agonist may not be capable of treating the agitation associated with anti-muscarinic agents.
Conclusions: This report suggests that dexmedetomidine should not be the first line sedative for the treatment of anti-muscarinic toxicity.

42. Unexpected Meltdown: A Case of Drug-Induced Thrombocytopenia

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Background: Medications have been identified with causing drug-induced thrombocytopenia (DITP) when other causes of thrombocytopenia have been ruled out. Phenylethylamine (PEA) analogs such as MDMA have been associated with DITP. PEA analogs have also been found in OTC weight-loss supplements.
Hypothesis: Synthetic PEA analogs can cause DITP.
Methods: This is a single-patient chart review. A healthy 21-year-old male presented to the ED with gross, painless hematuria and petechiae and was subsequently found to have an undetectable platelet count. He had begun taking a weight-loss supplement, VPX Meltdown™, 4 days earlier and noticed petechiae within 24 h of the first dose. He denied use of any other chronic medications and took two aspirin tablets for a headache the day before presenting to the ED. During his hospital stay, the patient received intravenous immune globulin, high-dose methylprednisolone, and platelet transfusions. Bone marrow biopsy revealed changes consistent with idiopathic thrombocytopenia (ITP).
Results: Tests for HIV and CMV were negative. The patient was discharged to hematology follow-up with a platelet count of $26\times103/mm^3$. In the following months, his platelet counts fluctuated, seeming only to respond to high-dose steroids. Upon tapering steroids, his platelet count dropped from a peak of $95\times10^3/mm^3$ to $34\times10^3/mm^3$. Rituximab therapy was then initiated and his platelet count improved to $58\times10^3/mm^3$. Gas chromatography/mass spectrometry analysis of the supplement confirmed two PEA analogs in addition to caffeine and yohimbine.
Discussion: VPX meltdown™ contains R-beta-methylphenylethylamine and *N*-methyl-*B*-phenylethylamine. This case may suggest that newer synthetic PEA stimulants, such as cathinones, may also have the potential to cause DITP.
Conclusion: The PEA analogs in this weight-loss supplement may have been responsible for this patient's thrombocytopenia, ITP remains on the differential, but the temporal relation to starting the supplement and lack of other causative agents warrants continued surveillance and awareness of such cases.

43. The Incidence of CYP2D6 and CYP2C19 Medication Interactions In Emergency Department Patients

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Background: The hepatic cytochrome 2D6 (CYP2D6) is a saturable enzyme responsible for metabolism of approximately 25 % of known pharmaceuticals. CYP interactions may alter the efficacy and safety of prescribed medications and are not identified by medication interaction tools. The analgesic efficacy of hydrocodone is dependent upon CYP2D6 metabolism to hydromorphone. Many antibiotics, anticoagulants, and anti-hyperglycemics are 2C19 substrates yielding significant opportunity for interaction.
Objective: The purpose of this study was to determine incidence of CYP2D6 and CYP2C19 medication interactions in a cohort of ED patients.
Methods: A convenience sample of ED subjects was prospectively enrolled between June 1, 12 and October 31, 12. Subjects were included if they had self-reported pain or nausea. Exclusion criteria were patients who were unable to speak English, <18 years old, or previously diagnosed with chronic pain or cyclic vomiting. Detailed medication histories for the preceding 48 h prior to ED visit were obtained. Baseline pain and pain between 30 and 90 min after hydrocodone administration (as part of ED care) was quantified by visual analogue scale (VAS). Descriptive statistics were used to characterize the incidence of CYP2D6 and CYP2C19 interactions. This abstract represents the interim analysis of the initial 333 subjects in the dataset.
Results: Three hundred thirty-three of 446 subjects were consented (74.7 % consent rate). The median age was 39 years (range 18–89; IQR, 27, 52), and 36.0 % were male. One hundred fifty-three (45.9 %) patients were on ≥1 CYP2D6 medication and 65 (19.5 %) were on ≥2 CYP2D6 medications. Twenty-eight (7.8 %) of patients were on ≥1 CYP2C19 medications. There was a trend toward decreased VAS change in patients receiving hydrocodone and taking ≥1 CYP2D6 substrates or inhibitors.
Conclusions: CYP2D6 medication interactions are common. Initial results suggest decreased hydrocodone efficacy in patients taking ≥1 CYP2D6 substrates or inhibitors. CYP2C19 interactions are less common but may yield clinically significant interactions due to the high-risk medications dependent on this enzyme.

44. Marijuana Utilization in ED Patients in an Area with High Marijuana Availability

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Background: Marijuana utilization has become increasingly prevalent in states that have passed legislation increasing the availability of medical marijuana. As of October 2012, 17 states allow for consumption of marijuana for the treatment of a range of medical diagnoses defined at the state level.
Objective: The purpose of this study was to determine the incidence of marijuana utilization in a cohort of ED patients presenting with pain or nausea in an area with high marijuana availability.
Methods: A convenience sampled cohort of ED subjects were prospectively enrolled between June 1, 2012 and October 31, 2012. Subjects were included if they had self-reported pain or nausea. Patients were excluded if they were unable to speak English, were less than 18 years of age, or carried a diagnosis of chronic pain or cyclic vomiting. Detailed illicit drug ingestion histories for the preceding 48 h prior to ED visit were obtained. Descriptive statistics were used to analyze demographic and incidence data. Odds ratios and chi square were calculated to determine demographics associated with marijuana utilization.
Results: Three hundred thirty-three of 446 were consented (74.7 % consent rate). Overall, the median age was 39 years (range 18–89; IQR, 27, 52), and 36.0 % were male. Thirty-seven (11.1 %) endorsed using marijuana in the previous 48 h prior ED visit. In this group, the median age was 32 (range 19–70; IQR 25, 48) and 48.6 % were males. While there was a trend for users to be male, the association did not reach statistical significance (OR=1.8, 95 % CI 0.91, 3.58). The median test did not identify a statistical association with age (p=0.077). There was no association with race or ethnicity.
Conclusions: Marijuana utilization was observed in more than 10 % of patients across all demographics. There was a trend toward users being younger males though use occurs in all demographics. Physicians should educate patients about the health risks of marijuana.

45. Flumazenil to Diagnose Benzodiazepine Induced Delirium After Alcohol Withdrawal Syndrome: a Case Series at One Hospital

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Introduction: Both alcohol withdrawal (AWS) and benzodiazepines (BZD) can cause delirium. AWS occurs in up to 40 % of hospitalized patients. BZD-delirium can complicate AWS and prolong hospitalization. BZD-delirium can be diagnosed with flumazenil (FMZ), a GABA-A receptor antagonist. Antagonizing the effects of BZDs, FMZ is theorized to exacerbate symptoms of AWS and precludes its use.
Hypothesis: For patients being treated for alcohol withdrawal, FMZ can safely diagnosis and treat BZD-delirium.
Methods: Admission records were retrospectively reviewed for patients with the diagnosis of AWS who received both BZDs and FMZ from January 2011 to June 2012. Day of last alcohol consumption was estimated from available alcohol level or subjective history. Corresponding pharmacy records were reviewed.
Results: Fifty patients were included (average age 50.2 years). Alcohol levels were detectable for 28 patients with average 197 mg/dl (range 10–530). Forty-nine patients were treated with adjunctive agents, the most common being: anti-psychotics (n=34), opioids (n=14), clonidine (n=24), and phenobarbital (n=16). Average day of FMZ administration was 4.6 (range 1–10) and dose was 0.5 mg (range 0.2–1). At the time of FMZ administration, delirium was described as over-sedate (n=32), intermittently agitated (n=33), or both (n=30). Thirty-six (85.7 %) patients had objective improvement after receiving FMZ. Twenty-seven patients required more than one dose (average 6.2 doses over 1.5 days). There were no adverse events.
Discussion: This is the largest series of patients receiving FMZ to diagnose BZD-delirium after AWS. The safety profile for our patients may be explained by (1) presence of adjunctive agents such as phenobarbital, and (2) reducing initial dose of FMZ, if administered before day 4. During the treatment of AWS, if delirium is present on day 5, a test dose of FMZ may be considered to rule out BZD-Delirium.
Conclusions: FMZ can safely diagnose BZD-delirium during the treatment of AWS for our patients.

46. Early Non-Detectable Acetaminophen Levels in Patients Requiring *N*-Acetylcysteine Therapy

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Background: Oral acetaminophen (APAP) is rapidly absorbed in the small intestine. An initial, non-detectable serum APAP concentration often reassures clinicians of a benign ingestion. The following cases demonstrate that a non-detectable APAP level performed earlier than 4 h post-ingestion may not rule out APAP toxicity.

Case series: Case 1: A 35-year-old woman with a history of bipolar disorder reported ingestion of 50 tablets of Tylenol PM® (APAP 500 mg/diphenhydramine 25 mg). The patient's APAP level was <10 mcg/mL 1 h after ingestion. The patient had no significant exam findings and was admitted to psychiatry. A comprehensive toxicology panel later reported the presence of APAP, diphenhydramine, and venlafaxine. This prompted an APAP level at 14 h post-ingestion, which was 51 mcg/mL, and a continuous infusion of *N*-acetylcysteine was started. The patient completed the course of treatment with no negative sequelae. Case 2: A 38-year-old woman ingested an unknown amount of Tylenol PM® (APAP 500 mg/diphenhydramine 25 mg) with alcohol. She complained of abdominal pain and nausea. Her exam was notable for mild delirium and agitation, tachycardia, active bowel sounds, and moist axillae. A serum APAP level was <10 mcg/mL 2 h after ingestion. At 4.5 h, her serum APAP level was 203 mcg/mL, and a continuous infusion of *N*-acetylcysteine was started. Afterward, the patient had an uncomplicated hospital course.
Discussion: The two cases reported here demonstrate the delay in APAP absorption that can occur with co-ingestants known to delay gastric emptying. Clinicians who rule out acetaminophen toxicity based on a non-detectable level obtained earlier than 4 h after ingestion may fail to identify patients in whom *N*-acetylcysteine therapy is mandated.
Conclusion: Early undetectable serum levels of acetaminophen obtained at less than 4 h after ingestion are insufficient to rule out toxicity, particularly in the setting of co-ingestants that may delay gastric emptying.

47. Thrombotic Thrombocytopenic Purpura and Injection Use of Oxymorphone: Elucidating the Mechanisms

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Introduction: Thrombocytopenic thrombotic purpura (TTP) is a rare, life-threatening disease of unknown etiology. Endothelial injury plays a role in the pathogenesis of TTP; however, only a single case of heroin-associated TTP has been reported in the English medical literature. Recently, 12 TTP cases were associated with injection of anti-diversion formulated oxymorphone (Opana with Intac® technology, or ADF-oxymorphone) for non-medical purposes. This ADF-oxymorphone contains polyethylene oxide, polyvinyl alcohol and talc, no cases of TTP after oral administration have been described.
Question: The goal of this study is to categorize methods of ADF-oxymorphone manipulation for injection use, and to hypothesize potential risk correlates with TTP.
Methods: We analyzed crowd-sourced drug diversion data trends (Bluelight.ru), identifying methods of manipulating ADF-oxymorphone and modes of administration. We specifically queried a mega-thread related to the newest ADF-oxymorphone, which was commonly cited within other forums. The forum thread was extracted from the website and data was collected in Excel ® spreadsheets. We classified content on methods for modifying the ADF-oxymorphone formulation, or proscriptions against such practices. We then compared crowd-sourced data against known physicochemical properties of the components of ADF-oxymorphone.
Results: The most commonly recommended extraction methods were solute extraction (21.6 %), microwaving/freezing (15.7 %), and grinding (13.7 %). Crisping was reported by 3.9 %. Several commenters (11.8 %) directly advised against manipulating the drug, even after suggesting methods (see Table 1). PEO pyrolysis produces ethylene oxide monomers, which have been implicated in hypersensitivity and immune sensitization reactions. The physicochemical characteristics of polyethylene oxide allow it to form lamellar liquid crystal structures in aqueous media.
Conclusions: Heating of ADF-oxymorphone causes production of the ethylene oxide monomer, which produces immune sensitization and thrombocytopenia. The incompatibility of other liquid crystals with human blood suggests that similar studies are essential in understanding the role of intravenous PEO in causing TTP.

Table (Neavyn Abstract): Definition and incidence of terms used in drug extraction procedures

Term	Definition	Proportion
Crisping	Any process by which direct heat is applied to the tablet, otherwise known as pyrolysis	3.9 %
Microwave/ freezing	Heating in the microwave and cooling rapidly	15.7 %
Grinding	The use of any tool (ordinarily a "PedEgg®" or "Dremel®") to powderize the tablet	13.7 %
Excipient dilution	The use of either an inert substance like baking soda or another prescription drug of abuse more easily powderized to be mixed with primary drug	1.96 %
Solute extraction	Any process by which the parent drug is dissolved in either aqueous or organic solvents (including water, vinegar, soda, ethanol and methanol)	21.6 %

48. A Description of Toxicology-Related Hospital Admissions within a Community-Based Healthcare System

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Objective: The purpose of this study was to describe characteristics of toxicology-related hospital admissions to a non-academic, community healthcare system. We investigated hospital admission rates, agents involved, and hospital length of stay (LOS).
Methods: We performed a retrospective review of toxicologic admissions to 13 Northern California hospitals, over 3 years. Cases were identified by a search of diagnosis codes. Any admitted toxicologic case was eligible. A single reviewer abstracted medical records for demographic information, level of care, hospital LOS, toxicologic category, exact agent(s), and mortality.
Results: There were 22,804 ED visits for toxicologic reasons between November 2008 and October 2011. 1,970 cases (8.6 %, CI 8.3, 9.0) were admitted. The mean patient age was 46.9 years (CI 45.9, 47.9). Two hundred eight were under 18 years. There were 734 males (37.3 %, CI 35.1, 39.4). Six hundred four (30.7 %) patients were admitted to an ICU, 151 (7.7 %) step-down units, and 690 (35.0 %) telemetry. The mean LOS was 71.1 h (CI 66.3, 75.9). There were 16 inpatient deaths (0.8 %, CI 0.4, 1.2). Of the 1,459 overdose (OD) cases (74.1 %), the top four drug categories were: opioids (30.1 %), sedatives (30.7), acetaminophen (15.4 %), and anti-depressants (13.3 %). Intentional ODs represented 871 (59.7 %, CI 57.2, 62.2). Opioids and/or sedatives were involved in slightly over half of OD cases (50.3 %, CI 47.8, 52.9). Cases involving opioid OD had longer mean LOS than those that did not (81.9 vs 60.0 h, difference 22.0, CI 9.0, 35.0).There were 774 (53.1 %, CI 50.5, 55.6) admissions for single-agent ODs. The agent with the highest mean LOS was lithium (102.9 h vs 61.8, difference 41.1, CI 8.7, 73.5). Prescription opioids also had increased LOS when compared to other agents (72.3 h vs 59.9, difference 12.4, CI 1.5, 23.2).
Conclusion: We found significant numbers of toxicology-related hospitalizations. These were associated with low mortality rates. Prescription opioids and sedatives are responsible for a large percentage of OD admissions.

49. Occupational Exposure to Hexavalent Chromium in Chrome Platers: a Case Series

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Background: Hexavalent chromium (CrVI) is a carcinogen that is rapidly reduced to its non-toxic form (CrIII) in vivo. Erythrocyte (RBC) chromium is a marker of exposure as only CrVI can cross the RBC membrane where it is entrapped as CrIII. Nine workers were evaluated in a medical toxicology clinic after exposure to chromium at a plating facility with dysfunctional ventilation and insufficient availability of personal protective equipment (PPE). Ambient air CrVI concentrations reached 1,100 μg/m^3 (OSHA PEL 5 μg/m^3).
Hypothesis: Inadequate adherence to engineering controls and use of PPE increases risk of chromium toxicity.
Methods: Demographic, exposure, clinical, health, and laboratory data were collected. Serum and RBC chromium concentrations and complete metabolic profiles were ordered.
Results: Demographic, exposure, clinical and health data are presented in the table. All patients complained of nasal irritation and most had chronic epistaxis. Median serum chromium concentration was 0.3 (range, 0.1–62.8 mcg/L, reference range [RR] <= 1.4 mcg/L) and median RBC chromium concentration was undetectable (range, undetectable–89 mcg/L, limit of detection [LOD]=1 mcg/L). Three patients had detectable RBC chromium concentrations. All complete metabolic profiles were unremarkable.
Discussion: History, physical findings, and lab data confirm chromium poisoning in all patients. Patient 8 had elevated RBC chromium despite 40 weeks since his last exposure. Given the average RBC lifespan of approximately 120 days, this suggests a possible sequestered pool of CrVI within the patient's body.
Conclusion: Hexavalent chromium toxicity can occur in occupational settings with inadequate adherence to engineering controls and PPE use.

Table (Pomerleau Abstract): Chromium levels and patient characteristics

	Age	Sex	Serum chromium (RR ≤1.4 mcg/L)	RBC chromium (LOD=1 mcg/L)	Time since last exposure (weeks)	Nasal septal perforation (P) or ulceration (U)	Dermal chrome holes
Pt 1	55	M	7.0	22	<1	+P	+
Pt 2	56	M	0.1	Undetectable	<1	+U	–
Pt 3	50	M	0.3	Undetectable	20	+P	–
Pt 4	51	M	0.2	Undetectable	5	+U	–
Pt 5	44	M	0.6	1.1	<1	+P	–
Pt 6	51	M	0.6[a]	–	3	–	+
Pt 7	53	M	0.1	Undetectable	<1	+U	+
Pt 8	44	M	62.8	89	40	+P	+
Pt 9	56	M	0.3	Undetectable	4	+P	–

[a]Whole blood specimen, reference range≤1.2 mcg/L

50. Intravenous Lipid Rescue Therapy May Interfere with Laboratory Analysis of Serum Biomarkers of Liver Injury

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Background: Intravenous lipid rescue therapy (LRT) may be implemented to decrease drug toxicity. Little is known about LRT interference with laboratory tests in overdose settings.
Hypothesis: Lipemia from LRT can interfere with analysis of liver function tests.
Methods: In this case report, we perform a chart review of a single patient treated with LRT after drug ingestion.
Results: A 54-year-old male with a history of depression consumed unknown amounts of diphenhydramine, amitriptyline and acetaminophen (APAP). Initial work-up showed AST of 138 U/L, APAP 177 mcg/ml, and a QRS interval of 136 ms. *N*-acetylcysteine (NAC), sodium bicarbonate, and 20 % intravenous LRT (100-ml loading dose, infusion of 0.25 mL/kg/min) were initiated. Labs drawn less than 6 h later showed an APAP 44 mcg/ml and an undetectable AST (Siemens Vista 1500 analyzer, lower limit of detection: ALT=6 U/L, AST=3 U/L). NAC and LRT infusions were stopped. Eight hours later, serum AST was measured at 488 U/L, and increased over the next two days to a peak of 1,600 U/L before recovery.
Discussion: Given a gradually rising course of AST following APAP ingestion, a single undetectable measurement is highly unlikely and probably erroneous. NAC and sodium bicarbonate have not been reported to interfere with liver enzyme assays. However, for this Siemens analyzer, serum lipid concentrations greater than 400 mg/dL cause interference with the AST measurement. Because lipid levels greater than 400 mg/dL with other similar analyzers are known to falsely decrease the AST, it is possible that extreme lipemia caused this laboratory result, a triglyceride level of 3,648 mg/dL has been reported after LRT infusion. This conclusion is limited by the lack of repeat measurement of liver enzymes or measurement of serum lipid levels, it is also possible that the blood sample was drawn from the line infusing LRT.
Conclusion: LRT may cause lipemia that interferes with the assay for liver enzymes

51. Paradoxical Benefit of Drug Shortages: Decreased ICU Admission Rate for Alcohol Withdrawal

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Background: Our institution-wide approach to alcohol withdrawal (AW) involves escalating doses of intravenous diazepam. When drug shortages removed diazepam from our approach, our guideline was adapted to utilize oral chlordiazepoxide in patients who could tolerate oral therapy.
Purpose: The purpose of this study was to compare admission rates to the ICU for AW before and during the diazepam shortage.
Methods: All patients from September 2011 to April 2012 with an admission diagnosis of AW were identified in the hospital admission database. Those admitted to the ICU were identified. Admissions were divided into periods of relative shortage (minor: December 2011, March–April 2012; severe: January–February 2012) and periods of normal supply (September–November 2011). Admission rates to the ICU for AW were defined as the number of admissions to the ICU for AW divided by the number of admissions to the entire hospital for AW.
Results: Prior to the shortage the ICU admission rates were 39, 49, and 66 %. During the minor shortage in December 2011, the admission rate decreased to 36 %. During the severe shortage in January–February 2012, the ICU admission rate decreased further to 23 and 19 %. During the minor shortage in March–April 2012, the admission rates increased to 43 and 48 %. Comparing two months before the shortage, October–November, to January–February during the shortage, there was a 35 % drop in the ICU admission rate (56 versus 21 %, $p<0.0001$ Fisher's exact test).
Discussion: ICU admission rates fell during periods when diazepam was not available. The reasons are not clear, but may be due to pharmacokinetic differences between the drugs or their routes of administration. A limitation is that we do not know that the patients in the various time periods were similar.

Conclusion: Oral chlordiazepoxide should be compared to intravenous diazepam in a prospective fashion for the treatment of AW.

52. Hypotension and Acute Kidney Injury from Overdose of Losartan and Telmisartan

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Background: Angiotensin-receptor blockers (ARBs) are commonly prescribed anti-hypertensive medications. There is a paucity of literature describing overdose with these drugs. We describe a case of a 30-year-old male who developed hypotension and acute kidney injury after an intentional ingestion of losartan and telmisartan.
Case Report: A 30-year-old male with no prior history, arrived via emergency medical services after patient intentionally ingested a total of 1.25 g (25 tablets of 50 mg) losartan and 1 g (25 tablets of 40 mg) of telmisartan, neither of which was his own medication. Initially he had a heart rate of 105 bpm and a blood pressure of 130/72 mmHg. Approximately 3 h from presentation, he developed mild hypotension with a blood pressure of 88/43 mmHg. It resolved with intravenous fluids administration. On laboratory evaluation, his initial creatinine was 0.91 mg/dL approximately 1.5 h after ingestion. It increased to 1.35 mg/dL at 10 h post-ingestion, 1.41 mg/dL after 12 h, and subsequently plateaued at 1.5 mg/dL 36 h after his ingestion despite normal saline hydration of 250 ml/h over that time period. He was discharged from the hospital in stable condition but was lost to follow-up. Losartan, losartan metabolites, and telmisartan were confirmed in the patient's serum by liquid chromatography–time of flight mass spectrometry analysis. No other drugs were detected.
Discussion: Overdoses of losartan and telmisartan are rarely reported. Hypotension and acute kidney injury has not been previously reported in the literature with regard overdoses of these agents alone. The delayed and prolonged serum creatinine elevation seen in this case suggests that repeat kidney function tests may be warranted in cases of large ARB ingestions. Further research is needed to determine appropriate testing intervals.

53. Intentional Lamotrigine Overdose Leading to Prolonged Elevation in Serum Lamotrigine Concentrations and Serotonin Syndrome

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Introduction: Experience with the effects of lamotrigine in overdose is limited. Previous case reports describe cardiovascular toxicity, seizures, and altered mental status. Lamotrigine toxicity presenting with serotonin syndrome and a significant delay in peak serum concentration have not been described.
Hypothesis: Lamotrigine can cause serotonin syndrome, furthermore, in overdose, patients may have significant delays in time to peak serum lamotrigine concentration.
Methods: This is a single-patient chart review. A 53-year-old man was found unresponsive in the woods approximately 12 h after ingestion of a homemade "slurry" of dissolved prescription medications found at the scene. His known prescription medications included lamotrigine, bupropion, zolpidem, phenytoin, and alprazolam. During air transport, he had one seizure-like episode. On assessment, had a temperature of 35.4 °C, heart rate 76 bpm, a respiratory rate 12/min, and blood pressure 114/74 mmHg. His physical examination was significant for altered mental status, lower > upper extremity rigidity with bilateral sustained clonus, and hyperreflexia. Electrocardiogram revealed normal intervals. Phenytoin was undetectable. Initial serum lamotrigine level was 29.4 μg/mL (normal high <20 μg/mL) and subsequent levels demonstrated a peak concentration of 41.7 μg/mL on HD 3 (see Table 1). Gas chromatography/mass spectrometry revealed lamotrigine, zolpidem, nicotine, and caffeine. He was intubated for airway protection from HD 2 to HD 9. He made a full recovery and was discharged on HD 14.
Discussion: Lamotrigine's purported mechanism of action includes voltage-gated sodium channel blockade and regulation of glutamate release. Inhibition of 5-HT uptake has been demonstrated in rats which makes the clinical presentation of serotonin syndrome mechanistically plausible. Finally, this is the latest a peak serum concentration of lamotrigine following overdose that has been reported.
Conclusion: Lamotrigine causes serotonin syndrome and peak serum concentrations may be significantly delayed.

Table (Shulman Abstract): Lamotrigine concentration versus time.

Time (days)	Lamotrigine concentration (μg/mL)
0.62	29.4
1.97	33.0
2.17	37.1
3.67	41.7
3.99	37.4
4.63	25.7
5.62	19.1
6.18	13.9
7.19	4.7

54. Impact of Training and Practice Setting on the Physician's Opinion Regarding the Treatment of Calcium Channel Blocker Poisonings

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Background: A recent study showed that 58 % of calcium channel blocker (CCB) poisoning cases are not treated according to the Poison Control Center's (PCC) recommendations.
Purpose: The objective of this study was to evaluate if the opinions of emergency physicians regarding the treatment of CCB poisonings are influenced by their training and practice setting.
Methods: A survey was conducted among emergency physicians working in the Province of Quebec (September 2008 to 2011). A weight-based group sampling method was used to identify the emergency departments (EDs) where clinicians were invited to participate. During one of the ED meetings, clinicians were asked to select their management for six diltiazem-poisoning scenarios, and identified which resources were available at their hospital and possible influencing factors on their management strategies.
Results: A total of 140 emergency physicians (19 EDs) participated in the study. A greater proportion of FRCPC(EM) and CCFP(EM) clinicians considered the administration of calcium and high-dose insulin euglycemia therapy (HIET). Clinicians from secondary and tertiary centers were also more prone to include these approaches. Family physicians (FPs) and those in primary centers ordered atropine and external pacemaker in a greater proportion. The reported unavailable resources varied mainly depending on the practice setting. Only FPs mentioned the PCC as an influence on their management strategy.

Discussion: Participants may be subject to desirability bias. Nevertheless, the previously mentioned retrospective study identified that HIET was often not started when indicated, consistent with results in the survey in this report, and decontamination seemed to be erratic, as reflected in the diversity of reported approaches in this study. Therefore, this suggests that the physicians' responses may indeed reflect how they would manage a real case.
Conclusion: The emergency physicians' opinion regarding treatment of CCB poisoning can be influenced by training and practice setting.

55. Blood Leak Alarm Interference by Hydoxocobalamin is Hemodialysis Machine Dependent

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Background: Hydroxocobalamin has been reported to interfere with the blood leak alarm on hemodialysis machines making it difficult to use this treatment modality after hydroxocobalamin infusion.
Hypothesis: We hypothesized the interference with hydroxocobalamin is related to the optical properties of the medication and would trigger the blood leak alarm in the machines tested.
Methods: This was a laboratory study. Hydroxocobalamin was reconstituted per package insert. Food coloring was added to 0.9 % saline to create the colors of the visual spectrum. Optical properties of absorbance and transmittance were measured. Hydroxocobalamin and the saline solutions were infused into the Fresenius 2008K™ and the Gambro Phoenix X36™ machines. Times were recorded from the start of the machine until the solution finished or the alarm triggered.
Results: When evaluating the Gambro Phoenix X36™ machine and dialysis circuit, the alarm did not trigger. In contrast, the blood leak alarm on the Fresenius 2008K™ machine was tripped by both the red solution and hydroxocobalamin infused per the package insert. The alarm stopped the machine between 128 and 132 s for the red solution and between 30 and 35 s with the hydroxocobalamin. Membranes of the circuits where the alarm tripped were examined and remained intact without blood. Results were validated on different machines with new circuits.
Conclusion: Hydroxocobalamin infusion per package insert and the red saline solution prepared with Red Dye 40 both triggered the blood leak alarm and stopped the Fresenius 2008K™ machine. However, this was not true for the Gambro Phoenix X36™ machine as the alarm never triggered. The interference with the Fresenius 2008K™ appears colorimetric due to normal saline with Red Dye 40 triggering the alarm. We alert physicians to become familiar with the properties of individual dialysis machines prior to use of hydroxocobalamin. When facing difficulties with hemodialysis after the administration of hydroxocobalamin, consider attempting with a different manufactures machine or model.

56. Button Battery Burns: Lessons from Oscar Mayer

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Introduction: Button battery ingestions represent a pediatric emergency due to the risk of esophageal impaction. When this occurs, emergent endoscopic removal is warranted, to prevent burns and perforation of the adjacent tissues. We developed a realistic model of esophageal button battery burns, in order to assess the time course of injuries caused by these objects to living tissues.
Hypothesis: Button battery burns will develop when a complete electric circuit is created between the disk battery and the model of living tissue.
Methods: Disk-shaped electric batteries (made of silver oxide or lithium) were placed inside slits cut into low-salt beef hot dogs. A 5-cent nickel coin was used as a control and also similarly positioned. Any changes to the inner surfaces of the hot dogs, adjacent to each metal object, were analyzed at 30, 60, 120 and 180 min, and photographic documentation made for comparisons.
Results: Button batteries induced circumferential tissue damage, while the nickel coin caused no changes. The changes were voltage dependent (burns with 3-V batteries being more extensive than with 1.5-V batteries), and worsened over time for all batteries. Burns from the 3-V lithium disks were noted as early as 30 min from contact initiation.
Discussion: Our hot dog model demonstrates that irreversible damage can occur within the first 30 min of button battery ingestion with some disk batteries, and provides a convincing model for the study of this pediatric injury. Future studies using liquid electrical insulators (such as oils) with this model may identify strategies to mitigate or delay the burn onset.
Conclusion: A visually arresting demonstration such as ours is useful for increasing public and clinician awareness about button battery burns, and may lead to improved treatment strategies for these serious ingestion hazards.

57. Role of Online Modules in Supplementing Emergency Medicine Residency Toxicology Education

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Background: While life-threatening toxicologic emergencies are rare, their recognition and timely intervention remain critical. Emergency medicine residents receive limited formal toxicology training.
Purpose: The objective of this study was to determine if online modules are feasible education tools for teaching emergency medicine residents about toxicologic emergencies.
Methods: Between August and October 2012, 46 emergency medicine residents completed an observational survey consisting of four online modules covering carbon monoxide exposure, toxic alcohol ingestion, digoxin overdose and beta-blocker overdose. Modules were authenticated by a board-certified toxicologist and designed to highlight the clinical presentation and treatment of the toxidrome. Residents completed pre and post module surveys using a five-point Likert scale. A ten-question multiple-choice test was developed to measure the residents' knowledge of the clinical presentation and treatment priorities for each of the toxidromes. This test was completed before and after the module to assess knowledge acquisition, analyzed with a paired *t* test.
Results: Residents reported enjoying online learning before (65 %) and after the module (67 %). More residents preferred online learning (37 vs. 30 %) and thought their knowledge retention was higher when compared to classroom learning (30 vs. 17 %) after study completion. Fifty-eight percent of residents would be willing to participate in a similar module again. Overall, there was significant improvement in scores after taking the module, (56 to 72 %, $p<0.01$). PGY-1 residents demonstrated the largest improvement, followed by PGY-3's. (Table)
Discussion: Emergency medicine residents enjoyed using online modules for continuing education of toxicology cases and would be willing to participate in a similar online module again.
Conclusion: Online modules are feasible tools for use in the education of emergency medicine residents regarding toxicologic emergencies.

Table (Werner Abstract): Pre- and Post-Knowledge Test Scores by Resident Class

	Pre-test	Post-test	*P* value
PGY-1	46 %	73 %	<0.01
PGY-2	64 %	66 %	0.83
PGY-3	59 %	76 %	<0.01
All classes	56 %	72 %	<0.01

58. Comparison of Psychoactive Bath Salt and Synthetic Cannabinoid Cases Pre- and Post-Federal Legislative Ban –Evidence of Effective Control Measures in New York State

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Background: Psychoactive bath salts and synthetic cannabinoids (K2) are designer drugs that were sold as novelty products "not for human consumption" in order to bypass existing drug laws. Hospitalizations from these drugs were seen with increasing frequency in Upstate New York leading up to the July 2012 federal synthetic drug ban.
Research question: Was federal legislation, enacted in July, 2012, effective in reducing bath salt and K2-related hospitalizations in Upstate New York?
Methods: A retrospective review of SUNY Upstate Poison Center calls and University of Rochester Medical Center (URMC) Toxicology Consultation census comparing K2 and bath salt cases pre- and post-federal synthetic drug legislation.
Results: SUNY Upstate Poison Center bath salt calls increased pre-ban from March to July with peak calls (103) occurring in July (Table 1). This was followed by steep decreases in August (29) and September (19) and October (3). Calls for K2 showed a similar drop from a mean of 30.3 (March–July) to 12 in August and 7 in September and October. URMC Toxicology cases averaged two consults per month for bath salts from May to July followed by no cases in the 3 months following the ban. For K2, the consult service averaged three consults per month prior to the ban with only a single consult documented in the 3 months following.
Discussion: New York was among the first states to enact legislation restricting specific bath salts and synthetic cannabinoids. Despite this, ED visits and hospitalizations from these drugs were prevalent until the federal ban that added 31 specific synthetic compounds to lists of banned substances and created an analogue clause for additional synthetic chemicals was enacted in July 2012.
Conclusion: Legislation restricting synthetic drugs was effective in reducing health-related consequences from abuse of bath salts and synthetic cannabinoids in Upstate New York.

Table (Wiegand Abstract): Monthly case counts before and after legislation

Pre-/Post-ban 7/9/2012	SUNY PC bath salt	URMC bath salt	SUNY PC K2	URMC K2
March 2012	21	2	50	5
April 2012	29	1	20	4
May 2012	39	3	18	2
June 2012	79	2	20	1
July 2012 (ban enacted)	103	1	45	2
August 2012	29	0	12	0
September 2012	19	0	7	1
October 2012	3	0	7	0

59. Chronic Methoxetamine Exposure Causes Significant Glomerular and Tubular Tidney Toxicity in Mice

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Background: Methoxetamine is a novel psychoactive substance that is an arylcyclohexylamine derivative of ketamine. There have been increasing reports of ketamine-related bladder toxicity, animal models have shown that ketamine can also cause kidney toxicity.
Research question: The study aims to determine the pattern of kidney toxicity associated with chronic methoxetamine exposure in a mouse model.
Methods: Two-month-old Institute of Cancer Research (ICR) mice were administered 30 mg/kg/day methoxetamine intra-peritoneally (n=5) or saline (n=3, control) for 3 months. The animals were then sacrificed and histological examination of the kidneys was undertaken. Glomerular damage was assessed by calculating the percentage of glomeruli in randomly selected 25-μm^2 areas that showed atresia, shrinkage, or increase in cellularity. Proximal tubular cell damage was assessed by calculating the percentage of total tubular cells in randomly selected areas of 15 μm^2 each that were dying, lytic, or degenerating. The study was approved by the Animal Experimentation Ethics Committee of the Chinese University of Hong Kong.
Results: The kidneys of all methoxetamine-treated animals showed inflammatory cell infiltration, tubular necrosis, degeneration / shrinkage of glomeruli and tubular colloidal casts. There was a greater proportion of abnormal glomeruli in methoxetamine-treated animals (23.50±14.28 %) than in control animals (10.17±13.08 %), $p<0.001$. Similarly, there was a greater proportion of proximal tubular cell degeneration in methoxetamine-treated animals (20.36±5.57 %) than in control animals (2.90±1.30 %), $p<0.001$.
Conclusions: We have shown in this study that 3 months of methoxetamine exposure is associated with significant kidney damage both at a glomerular and tubular level. Previous work has suggested that methoxetamine is also associated with bladder toxicity, similar to that seen with ketamine. Animal models such as this are important to determine the potential pattern of chronic toxicity associated with novel psychoactive substances to ensure that clinicians can provide evidence based education to drug users.

60. Acute Elemental Mercury Poisoning Masquerading as Fever and Rash

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Background: Acute elemental mercury (Hg) poisoning and acrodynia are often described as distinct presentations associated with Hg exposure. Acute elemental Hg poisoning presents typically with pneumonitis while acrodynia presents with pink, often desquamating, palms and soles without fever.
Research question: High fever and diffuse rash can be the initial presentation of acute Hg poisoning.
Methods: Two siblings (14-year-old male and 9-year-old female) presented to the ED with fever and rash. They were discharged home with viral syndrome. The next day, they returned to the same ED with persistent fever and rash and were admitted. A third sibling (11-year-old female) developed similar symptoms and was admitted. All three children had diffuse confluent maculopapular pruritic rashes sparing the palms and soles. Other symptoms exhibited by one or more of the three siblings: high fever (107.2 °F), headache, petechiae, conjunctivitis, dry cough, pharyngitis, and diarrhea. On the second ED visit, the 14 year old brought a bottle containing 300 g of 99.9 % elemental Hg that the three siblings had been playing with over the last 10 days. Environmental testing for Hg was performed at the house, blood (b) and urine (U) testing Hg testing was performed on all three siblings.
Results: Home Hg vapor levels were 50 mcg/m^3. Initial Hg levels were: 14 year old, >160 mcg/L (b), 141 mcg/L (U); 11 year old, 137 mcg/L (b) 215 mcg/L (U); and 11 year old 79 mcg/L (b), 78 mcg/L (U). Viral studies were negative. Hg poisoning was diagnosed, all siblings were chelated.

Discussion: Although acute exposure to elemental Hg is often manifested by pulmonary injury and acrodynia, our cases demonstrate that acute elemental Hg exposure can present with a diffuse rash that spares the palms and soles, and fever.
Conclusion: In the appropriate setting, rash and fever can be clinical features of elemental Hg toxicity.

61. The Fall of OxyContin® and the Rise of Opana®: Use of Google Trends to Monitor Drug Diversion Behaviors

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Background: Prior research documents the use of web traffic surveillance to identify drug diversion and diversion techniques. More than 80 % of web searches are initiated via Google and are subsequently available via Google trends, a tool that has been used to monitor behaviors related to flu-like illnesses and economic indicators.
Hypothesis: Internet searches related to drug diversion may shift as attitudes and behaviors change following the introduction of novel anti-diversion drug formulations.
Methods: This is a retrospective analysis of a publicly available web database (Google Trends) that identifies the number of times a search term is entered relative to the total search volume across geographic regions and time. Investigators identified search terms associated with diversion of oxycodone (OxyContin® and Percocet) and oxymorphone (Opana) then correlated results with the announcement and release of new, diversion-resistant formulations.
Results: Searches related to intravenous injection of OxyContin® peaked during September 2010, following the August release of a diversion-resistant reformulation, then dropped precipitously to 18 % of their peak level. In the same month, searches related to intravenous injection of Opana rose, and continued to increase as the number of OxyContin® searches fell. During the same period, searches for intravenous injection of Percocet remained steady, at around a third of peak search volume.
Discussion: The surge in searches related to intravenous OxyContin® use is likely related to renewed interest in novel techniques for non-medical use following the release of the abuse-deterrent reformulation. The precipitous drop in searches following this, along with the rise in searches related to intravenous abuse of opana, reflects shifting patterns of diversion and abuse. Of note, the relatively stable search popularity related to intravenous Percocet abuse during a period without reformulation provides an internal control.
Conclusion: Continued use of Google Trends to monitor web searches related to drug diversion may predict diversion behaviors.

Previously Presented Research: Poster Presentations

The following research abstracts have been presented in another scientific meeting, but have not been previously published.

62. Intravenous Lipid Emulsion Does Not Reverse Dabigatran Induced Anticoagulation in a Rat Model

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Background: The anticoagulant dabigatran has no reversal agent and may cause life-threatening bleeding in patients with trauma or closed space hemorrhage. Intravenous lipid emulsion (ILE) is thought to create a lipid compartment in serum that sequesters lipophilic drugs. Dabigatran is lipophilic and its anticoagulant effects are concentration dependent.
Research question: Can ILE therapy reverse the anticoagulant effects of dabigatran?
Methods: Twenty rats were randomized, ten in the ILE group and ten in a normal saline (NS) control group. Animals had a baseline tail bleeding time (T0) followed by oral dabigatran administration (15 mg/kg). At 45 min (T45), a second tail bleeding time was performed, followed by a 7-min intravenous infusion of 15 ml/kg of ILE or NS. A final 60-min (T60) bleeding time was obtained. An ILE-only group of five animals had bleeding times assessed prior to (T0) and 15 min after (T15) ILE therapy. Comparisons were made using *t* tests.
Results: Between T0 and T45, average bleeding times increased from 109.5 s [95 % CI 94–125] to 231.8 s [95 % CI 193–271] ($p<0.0001$). Between T45 and T60, bleeding times in the ILE group decreased by 31.5 s [95 % CI −77 to +14] and the NS group decreased by 6 s [95 % CI −67 to +55], not statistically significant (p=ns). In the five ILE-only animals, the average bleeding time at T0 was 114 s which increased significantly at T15 to 237 s ($p=0.006$).
Discussion: Although ILE itself significantly prolonged bleeding times, when administered to dabigatran anticoagulated rats, bleeding times decreased, but not significantly. There may be a complex interaction of ILE with dabigatran that this study was not able to elucidate.
Conclusion: The anticoagulant effects of dabigatran are not reversed with ILE therapy and ILE itself affects bleeding times in this rat model.

63. Prevalence of Xylazine in Postmortem Cases Related to Heroin and/or Cocaine Intoxication

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Background: Xylazine, a dangerous veterinary sedative in humans, has been found as an adulterant of street heroin in Puerto Rico. It was also found with free morphine and 6-acetylmorphine (6-AM), codeine, cocaine, and benzoylecgonine (BE) in postmortem cases at the Puerto Rico Institute of Forensic Sciences (PRIFS).
Research question: What is the prevalence of xylazine in postmortem cases related to heroin and/or cocaine intoxication?
Methods: This is a retrospective study from 75 cases submitted in 2008 to 2010 that were reanalyzed for xylazine. The cases were selected according to the positive immunoassay results for cocaine and opiates, as well as the circumstances of death. Blood samples were analyzed by ultra performance liquid chromatography–tandem mass spectrometry (UPLC-MS-MS) and gas chromatography–mass spectrometry (GC-MS).
Results: In 36 out of 75 cases (48 %), xylazine was found in combination with heroin metabolites and/or cocaine or cocaine metabolites. From the 36 cases, 89 % (32) were males and 11 % (4) were female with ages ranging from 22 to 67 years old. The most common xylazine combination was heroin/cocaine / xylazine (37 %). The pathologist did not request the xylazine analysis in 40 of the 75 cases, in with xyalazine was present in 18 cases (45 %). Xylazine concentration ranged from 0.01 mg/L to 0.97 mg/L. The pathologist included xylazine in the causes of death in 9 out of 36 cases (25 %).
Discussion: The results observed in these 75 cases may suggest that xylazine should be included as a target compound in cases related to cocaine and heroin intoxication. The results may also suggest that drug users might be using “speedball”, a heroin and cocaine mixture.
Conclusion: The combination of xylazine and the typical drug of abuse may increase the fatalities among users. Therefore it is necessary to be aware of the emerging of xylazine in our community.

64. QT_C Prolongation and Torsades in Bupropion Overdoses Presenting to US Emergency Departments

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Purpose: Bupropion is an atypical antidepressant commonly used for depression and smoking cessation. It is structurally dissimilar to other anti-depressants and is and inhibitor of norepinephrine and dopamine uptake. It is associated with QTc prolongation in therapeutic use and in overdose. There is limited data assessing QTc prolongation and torsades de points (TDP) in cases of overdose. The purpose of this study is to assess the incidence of QTc prolongation and the development of TDP in cases of bupropion overdose presenting to emergency departments.
Methods: Design: A multi-center retrospective ED study design was utilized. Subjects: Consecutive patients with the primary ED diagnosis of antidepressant overdose were identified 21-month period. Epidemiologic data was collected as well of the occurrence of EKG QTc measurements and the development of TDP.
Results: Out of 1,590,248 consecutive ED patients from 20 EDs, 355 patients were identified with the primary final diagnosis of antidepressant overdose. Of these, 33 cases involved bupropion as the primary toxicant. The mean age of study subjects was 27.2 years (range, 1.5–58.7 years), 30 % were male, 67 % of cases were intentional ingestions. The mean bupropion dose ingested by history of 1,267 mg (range, 50–4,500 mg). The average QTc was 423 ms. 5 (15 %) cases had prolonged QTc measurements (>440 ms). There were no cases of TDP.
Conclusion: Bupropion overdose is rarely associated with QTc prolongation. No cases of Torsades de pointes were seen in this ED case series.

65. Valproic Acid Toxicity: Do Nontoxicologists Recognize and Treat It with Carnitine?

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Background: Valproic acid (VPA) is widely used and FDA-approved for seizures, migraines, mood disorders and schizophrenia. Hepatotoxicity and/or hyperammonemic encephalopathy may occur as a VPA complication.
Purpose: This study investigated current practice of screening for these VPA toxicities as well as the use of carnitine as an antidote at the study site.
Methods: A retrospective review was performed on patients in a tertiary care Emergency Department (ED) from October 1, 2010 to September 30, 2011 with VPA listed as a current medication in the electronic health record. A clarity search identified study patients. A standardized data extraction tool was developed. Descriptive statistics included Fisher's exact test for dichotomous variables. Analyses were conducted using SAS software.
Results: A total of 777 encounters were identified, of which 328 did not involve VPA-associated issues and 127 involved patients not initially on VPA. Of the remaining 322, 74 (23 %) were admitted and 248 were discharged. In the 322 encounters, altered mental status (61.8 %, n=123) and seizures (20.5 %, n=66) were the most common presenting symptoms. Ammonia concentrations were measured in 0.62 % (n=2) of ED only encounters and 4.66 % (n=15) of admissions ($p \leq 0.0001$). Patients evaluated by a toxicologist were significantly more likely to have an ammonia concentration obtained (5/6 vs. 12/316, $p<0.005$). Pre-encounter carnitine therapy was found in 2 % (n=6) of the 322, carnitine therapy was initiated in 50 % (n=3) of patients with a toxicology consult and 0 % without ($p<0.0001$).
Discussion: Patients taking VPA may present with related complications, often requiring inpatient management. Carnitine was used in relatively few patients with potential VPA complications. Toxicologist input increased monitoring for hyperammonemia as well as antidotal therapy with carnitine.
Conclusions: Education of nontoxicologists is needed to increase awareness of VPA-related complications, diagnosis and management

66. Pesticides Analysis by UPLC/MS/MS in Postmortem Human Gastric Contents Provide Evidence to Establish Suicide Cases by Oral Ingestion?

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Background: Forensic toxicology laboratories traditionally focus on analysis of blood, urine, and certain organs to determine intoxication as cause of death. A tendency of suicide cases by pesticide oral ingestion was observed at Puerto Rico Institute of Forensic Sciences.
Research question: Does ultra performance liquid chromatography tandem mass spectrometry detection of 14 pesticides in postmortem gastric content samples contribute to determine suicide cases by oral ingestion?
Methods: This is a retrospective study of 513 autopsy cases between 2009 and 2011 on which gastric content was submitted for pesticides analysis. Aliquots of 4 and 0.5 mL were extracted with pentane and acetonitrile, respectively. Positive pesticides controls were prepared in 0.1 N HCl at a concentration of 10 μg/mL and extracted. Supernatants were evaporated and reconstituted with 200 μL of mobile phase, 10 μL was injected at UPLC system. Chromatographic analysis was performed using a C18 BEH column and a gradient of 98:2 water/methanol with 0.1 % formic acid and acetonitrile. Sample ionization was by electrospray mode (ESI) using multiple reaction monitoring. Two transitions for each of the 14 pesticides were simultaneously monitored.
Results: In 28 out of 134 cases (21 %), at least one pesticide was detected. A total of 6 (21 %), 18 (64 %), and 4 (14 %) positive cases were detected on 2009, 2010, and 2011, respectively. Among positive cases, aldicarb was the predominant pesticide found (14 cases, 50 %) followed by malathion (14 %), disulfoton (11 %), oxamyl (11 %), carbaryl (7 %), and glyphosate (7 %).
Discussion: The methodology developed was able to successfully detect pesticides on postmortem gastric contents. Results obtained suggest that in addition to aldicarb, other restricted pesticides were present in suicide cases by pesticide intoxication. As well as the non-restricted pesticide glyphosate.
Conclusion: Toxicological analysis of gastric content in postmortem cases provides significant information to determine pesticide intoxication as cause of death on suicide cases.

67. The Confirmation of Xylazine in Seize Drug and Biological Fluids

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Background: The emerging drugs of abuse are a great concern to health professionals and public safety agencies. One of these emerging abuse drugs is xylazine. This drug is an α2 agonist, which has been approved by the FDA for animal use only. Analgesia, sedation, muscle relaxation, and hypotension are the main symptoms of this drug. The addict's population of Puerto Rico was using xylazine.
Research question: Is xylazine marketed as drug of abuse or is a heroin adulterant?
Methods: In order to asses the extent of xylazine, this study has been focused on detecting the presence of xylazine in different types of samples, confiscated drugs and postmortem biological fluids of cases related to xylazine use. Two-parts study was performed, the first part analyzes 80 samples of seized drug, using GC/MS technique. The second part analyzes postmortem samples such as blood, urine and vitreous humor, using UPLC/MS/MS technique.
Results: The seized drug analyses has confirmed xylazine presence. The presence of xylazine was detected in the 68 % of the total samples, of

which 11 % was xylazine only and 57 % was in combination with heroin. Moreover the results obtained from the analysis of the postmortem samples show that xylazine can be detected in three different matrices, blood, urine, and vitreous humor as parent drug. The higher concentration of xylazine in blood was 1.16 and 2.0 μg in urine and vitreous humor.
Discussion: Xylazine as drug of abuse was detected and related to fatal intoxication cases.
Conclusion: Our data indicates that xylazine is sold as drug of abuse to the addict's population of Puerto Rico. The potential harmful effect of xylazine in humans needs to be studied.

Previously Presented and Published Research

The following research abstracts have been presented in another scientific meeting, and have been published as below.

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