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ANNUAL MEETING ABSTRACTS

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1. Efficacy of Trypsin in Treating Coral Snake Envenomation in the Porcine Model

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Background: Though current definitive treatment for *Micrurus fulvius fulvius* envenomation is antivenin, this horse serum treatment carries risks, and the antivenin for *M. fulvius* (Eastern coral snake) envenomation is no longer in production. Therefore, investigation in alternative treatments for *M. fulvius* envenomation is warranted.
Research Question: The objective of this study is to assess the efficacy of trypsin, a protease, in an in vivo porcine model by the local injection of trypsin after *M. fulvius* venom injection.
Methods: Thirteen female pigs received a 1-mL subcutaneous injection of Eastern coral snake venom (10 mg/mL) in the right distal hind limb (27-gauge needle; depth, 3 mm) and were then randomized into control (n=7) or experimental (n=6) groups. One-minute post-injection animals were either injected with 1 mL of saline (control) or 1 mL of trypsin solution (experimental; 100 mg/mL) at the site of venom injection on the right distal hind limb of all pigs. Investigators responsible for assessment of toxicity and study endpoints were blinded to group assignment. Monitoring occurred continuously the first 4 h, at which point surviving animals were extubated, and then every 8 h for the next 3 days for signs of toxicity: respiratory rate<15 breaths per minute (bradypnea), apnea, falling pulse oximetry, and agonal respirations. Fisher's exact test was used to determine differences in the toxicity and survival rates in control versus treated animals.
Results: Control pigs were more likely to develop signs of toxicity (p=0.009) and less likely to survive to 12 (p=0.002) or 24 h (p=0.009) than treated pigs. Four of the six treated pigs survived to the end of the study, (3 days post-injection) versus 0 of the control pigs. The two trypsin treatment animals that did not survive showed signs of toxicity at 844.5 ±178.9 min versus controls 263.42±36.5 min.
Conclusion: Local injection of trypsin, a proteolytic enzyme, at the site of envenomation decreased the toxicity of eastern coral snake venom and increased survival significantly. Further investigation is required to determine the efficacy trypsin injection at later treatment injection times.

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2. Lipid Emulsion Rapidly Activates Insulin Signaling Both Alone and to Combat Toxicity During Bupivacaine-Induced Sensitization of IRS1

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Background: Recent publications have identified that local anesthetics uncouple insulinergic signaling by inhibitiing pi3k/Akt and lipid emulsion activates Akt/GSK-3β following ischemia–reperfusion. Furthermore, while it is clear that lipid emulsion exerts a cardiotonic effect, it is unclear through what pathway this effect functions.
Hypothesis: We hypothesized that bupivacaine uncouples insulinergic signaling which sensitizes the heart to insulinergic signaling during recovery (via feedback to IRS1) and lipid emulsion activates insulinergic signaling, potentiating the recovery effect.
Methods: Forty-two male Sprague–Dawley rats received 10 mg/kg bupivacaine over 20 s, followed by either nothing or 10 mL/kg ILE (30 % Intralipid®). Following sacrifice at 0 (control), 1.5, 5, or 10 min after start-of-infusion, heart, liver, and kidney were frozen and/or preserved. An additional set of three animals was exposed to 10 mL/kg ILE and sacrificed at the 5-min time point; a final set of three animals was pre-treated with pi3k inhihitor Wortmannin, then subjected to 10 mg/kg bupivacaine, and sacrificed at 10 min. Protein was extracted, and phosphorylation level was quantified for Akt, p70, s6, IRS, and Gsk-3β. Additional lysates were extracted for glycogen quantification. Tissue was also prepared for electron microscopy.
Results: High-concentration bupivacaine blocked insulinergic signaling (in heart and kidney) via rapid de-phosphorylation of Akt/GSK-3β/p70/s6. Once drug concentration dropped below channel blocking thresholds, a rebound hyper-activation was observed. Blocking insulin signaling with Wortmannin exacerbated toxicity indicating the need for sensitization during recovery. Lipid treatment rapidly phosphorylated upstream insulingergic targets (Akt) with a delayed re-phosphorylation of downstream targets in insulin sensitive tissue (heart) but not in insulin-insensitive tissue (kidney). Furthermore, in the absence of toxicity, lipid emulsion drove Akt phosphorylation. The sensitivity to insulin signaling was confirmed by increased glycogen accumulation in lipid treatment using both biochemical assay and electron microscopy.
Discussion: Bupivacaine toxicity blocks insulinergic signaling, and the sensitization to insulin-signaling via IRS1 de-phosphorylation is required for recovery. Lipid emulsion potentiates the recovery by its ability to drive insulinergic signaling in the absence of toxicity.
Conclusion: In addition to its ability to sequester toxins, the benefit of lipid emulsion in combatting cardiac toxicity may be modulated its pro-insulinergic effect.

3. Long-Term Outcomes Following Deliberate Self-Poisoning in Teens: A Population-Based Study

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Background: Suicide is the third most common cause of death among American teens, and deliberate self-poisoning is the leading method of

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attempted suicide. Unlike violent methods, survival following self-poisoning is common, providing an opportunity for secondary prevention. The long-term risk of completed suicide in teens following discharge from the emergency department after a first self-poisoning episode is unknown.

Objectives: Primarily to determine rates of suicide relative to controls and secondarily, to explore predictors of subsequent suicide.

Methods: Using multiple linked provincial healthcare databases, we conducted a population-based study of all teens aged 10 to 19 years presenting to an Ontario hospital after a first self-poisoning episode from 2001 to 2011 and compared their outcomes with age- and sex-matched controls (1:50).

Results: We identified 23,167 teens discharged after a first self-poisoning episode. Their median age was 16 (IQR 15 to 18) years, and 16,056 (69 %) were female. Acetaminophen was the most common agent ingested, followed by antidepressants and NSAIDs. Altogether, 3,838 (17 %) patients were subsequently hospitalized with repeat self-poisoning. The self-poisoning patients were compared with 1,158,350 matched controls for all analyses. Over a median follow-up of 7.7 (interquartile range (IQR), 4.6 to 10.1) years and cumulative 164,877 person-years, 127 individuals in the self-poisoning cohort committed suicide (0.55 %), compared with 362 suicides in the control group (0.03 %). The risk of suicide in the self-poisoning cohort was markedly increased relative to controls (adjusted hazard ratio (HR), 18.1 [95 % CI, 14.8 to 22.2]). The median time from first self-poisoning to suicide was 3.0 (IQR, 1.2 to 5.4)years. Predictors of suicide in self-poisoning teens included male sex (HR, 2.21; 95 % CI, 1.55 to 3.15), age older than 15 years on index self-poisoning (HR, 1.73; 95 % CI, 1.02 to 2.95), diagnosis of depression (HR, 1.59; 95 % CI, 1.06 to 2.38) and a visit to a psychiatrist in the previous year (HR, 2.15; 95 % CI, 1.42 to 3.26).

Conclusions: A first hospital presentation for deliberate self-poisoning during adolescence is a powerful predictor of subsequent suicide in the following decade. Half of all suicides occurred more than 3 years after the first self-poisoning episode, emphasizing the importance of sustained secondary prevention initiatives.

4. Utilization Patterns of Carisoprodol in Ambulatory Care and Emergency Departments, 2001–2010

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Background: Carisoprodol is a muscle relaxant with significant abuse potential that has been implicated in tens of thousands of emergency department (ED) visits annually, alone or in combination with other central nervous system (CNS) depressants.

Research Question: To characterize trends in carisoprodol utilization in US outpatient offices, clinics, and EDs in the setting of rising rates of prescription drug abuse and associated overdoses.

Methods: A retrospective review of data from the CDC's National Hospital Ambulatory Medical Care Survey (NHAMCS) and National Ambulatory Medical Care Survey (NAMCS) 2001–2010 was performed. All adult (age, ≥18 years) ED and ambulatory care visits during which carisoprodol was either administered or prescribed were included. Visits during which there was concomitant use of opioid analgesics (OAs) or benzodiazepines were also evaluated. The proportion of visits during which the included medications were administered or prescribed was tabulated, and trends were analyzed using survey-weighted logistic regression.

Results: Between 2001 and 2010, there were an estimated 7.6 billion adult ambulatory care visits, of which an estimated 28.2 million (0.4 %) visits included a carisoprodol prescription. Out of an estimated 900 million ED visits between 2001 and 2010, 2.1 million (0.2 %) visits received carisoprodol in the ED or at discharge. The proportion of carisoprodol utilization did not change significantly in the ambulatory care setting and decreased in the ED when 2001–2002 was compared with 2009–2010; however, there was an increase in the absolute number of visits over time. An OA was concomitantly used frequently with carisoprodol in both settings, but there was no proportional increase over time (Table). There was no adequate sample size to make reliable estimates regarding the concomitant use of carisoprodol and benzodiazepines.

Discussion: Utilization rates of carisoprodol might not have increased significantly secondary to more stringent controlled substance regulations over the past decade. Continued high rates of concomitant use with OAs, likely for such diagnoses as back pain, may contribute to subsequent misuse, abuse, morbidity, and mortality.

Conclusion: Utilization rates of carisoprodol did not increase significantly over time; however, providers must exercise caution when prescribing carisoprodol, particularly in combination with other CNS depressants to avoid adverse effects.

Table (Abstract 4). Trends in carisoprodol utilization over time

NAMCS	2001–2002 %, no. visits	2009–2010 %, no. visits	% Change	*P* value
Carisoprodol	0.3 % (4,636,134)	0.5 % (7,736,352)	66.7 %	0.098
Carisoprodol+OA	0.2 % (2,232,202)	0.3 % (4,255,556)	50.0 %	0.135
% Carisoprodol visits with OA	48.2 %	55.0 %	14.1 %	0.49
NHAMCS				
Carisoprodol	0.3 % (538,332)	0.2 % (376,580)	−33.3 %	0.003
Carisoprodol+OA	0.2 % (371,573)	0.1 % (246,253)	−50.0 %	0.015
% Carisoprodol visits with OA	69.0 %	65.5 %	−5.1 %	0.706

5. Clinical Risk Factors in ED Patients with Prescription Opioid Overdose

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Background: In the US, deaths from prescription opioids exceed deaths from all illicit drugs combined.

Research Question: What are risk factors for in-hospital severe respiratory depression (SRD) and mortality in emergency department (ED) patients with prescription opioid overdose?

Methods: This was a secondary data analysis of a prospective cohort of acute drug overdose patients presenting to two urban teaching hospital EDs from

2009 to 2013. We analyzed a subgroup with prescription opioids overdose with these exclusion criteria: pediatrics (<18), alternate diagnoses (e.g., sepsis), lacking data (e.g., eloped). Data included demographics, vital signs, blood gas, ED endotracheal intubation (ETI), naloxone administration, and toxicology screens. The study outcomes were (1) in-hospital mortality, and (2) SRD defined by either (a) naloxone administration or (b) ETI. Assuming a 20 % prevalence of predictors, we needed 300 patients to demonstrate threefold risk difference with 80 % power.

Results: Three hundred fifty-four patients were screened, of whom 47 were excluded (25 lack data, 10 alternate diagnoses, 9 pediatrics, 3 prisoners), leaving 307 patients for analysis (mean age, 44.7 years; 42 % females; 2.0 % mortality). Prescription opioid overdoses involved and corresponding SRD are listed in the Table. Demographic associations with specific opioids were: males with methadone ($p<0.001$), females with tramadol ($p<0.05$), hispanics with tramadol ($p<0.05$), and whites with buprenorphine ($p<0.05$). One hundred nine patients experienced SRD (90 naloxone alone, 9 ETI alone, 10 both). Mean age was higher in the SRD group (51.1 vs. 41.1, $p<0.001$), and suicidality was inversely correlated with SRD (odds ratio, 0.29; confidence interval (CI), 0.17–0.5), while gender had no correlation ($p=0.95$). Risk for SRD was highly dependent on the type of prescription opioid, with highest relative risks (RR) for fentanyl (RR, 22.5; $p<0.01$) and lowest for codeine (3.7 % SRD). Six patients died during their hospitalization, and mortality was significantly associated with initial tachycardia ($p<0.001$), hyperlactatemia ($p<0.05$), and initial hypotension ($p<0.01$).

Discussion: In this cohort of patients with prescription opioid overdose, relative risk for severe respiratory depression was significantly associated with age and specific opioid drugs, the highest of which was fentanyl (RR=22.5) and the lowest was codeine (RR=1).

Conclusion: Clinical risk factors for mortality included initial hemodynamic abnormalities and hyperlactatemia.

Table (Abstract 5). Risk of severe respiratory depression by prescription opioid

Prescription opioid	SRD rate (%)	RR (descending)	95 % CI	*P* value
Fentanyl	5/6 (83.3)	22.5	3.2–159	<0.01
Oxymorphone	2/3 (66.7)	18.0	2.2–144	<0.01
Tapentadol	2/2 (100)	15.5	3.0–79.9	<0.05
Methadone	59/116 (50.9)	13.7	2.0–95	<0.01
Hydromorphone	4/9 (44.4)	12.0	1.5–94	<0.05
Morphine	5/12 (41.7)	11.3	1.5–86	<0.05
Oxycodone	40/124 (32.3)	8.7	1.3–60	<0.05
Hydrocodone	9/31 (29.0)	7.8	1.0–58	<0.05
Buprenorphine	2/7 (28.6)	7.7	0.8–73	0.08
Tramadol	3/12 (25.0)	6.8	0.8–58	0.08
Codeine	1/27 (3.7)	1.0 (*ref*)	–	–

Severe respiratory depression is defined as receiving either naloxone or endotracheal intubation

Desc descending order, *RR* relative risk, *CI* confidence interval, *SRD* severe respiratory depression

6. Is CYP2C19 Genotyping Useful Prior to New Drug Administration in an ED Population?

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Background: CP450 polymorphisms result in variable rates of drug metabolism, which have implications for drug effectiveness and safety. The prevalence of CYP2C19 polymorphisms in an emergency department (ED) population is unknown.

Research Question: Is CYP2C19 genotyping useful prior to the prescription of a new medication in the ED?

Objectives: To determine the percentage of ED patients on CYP2C19-dependent drugs and to determine the prevalence of CYP2C19 polymorphisms in an ED population.

Methods: We conducted a prospective observational study in a single urban academic ED. Subjects were included if they had self-reported pain or nausea and were excluded if they were non-English speaking, <18 years old, had liver or renal failure, or had chronic pain or cyclic vomiting. Detailed drug ingestion histories for the 48 h preceding ED visit were obtained; each drug was coded as: not CYP2C19-dependent, CYP2C19 substrate, CYP2C19 inhibitor, or CYP2C19 inducer. Ten percent of patients were randomized to undergo CYP2D19 genotyping via whole blood assay using the Roche Amplichip.

Results: Five hundred two patients were included; 61 % were female, 65 % were Caucasian, and median age was 39 years (interquartile (IQR), 22–53). The median number of drugs taken in the 48 h preceding ED visit was 3 (IQR 1–6). Some 26 % of patients were taking a CYP2C19-dependent drug, with 23 % and 4 % of patients taking a substrate and inhibitor, respectively; no patients had taken an inducer. Four patients already taking a CYP2C19-dependent drug were given or prescribed CYP2C19 drugs in the ED (omeprazole, $n=3$; diazepam, $n=1$). Among 53 patients genotyped, 98 % were normal metabolizers and 2 % were poor metabolizers. There were no ultra-rapid metabolizers.

Discussion: In a population of ED patients presenting with pain or nausea, more than ¼ of patients reported taking a CYP2C19-dependent drug in the preceding 48 h. The prevalence of CYP2C19 polymorphisms was rare in this population. The likelihood of a clinically significant CYP2C19 drug–drug interaction in patients presenting with pain or nausea is low.

Conclusion: CYP2C19 genotyping is unlikely to be useful in an ED population, given that CYP2C19-dependent drugs with a narrow therapeutic window, such as clopidogrel, are not typically prescribed in this setting.

7. Risk Factors Associated with Opioid Analgesic Prescribing in a Cross-Section of Nineteen U.S. Emergency Departments

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Background: Opioid prescribing following emergency department (ED) visits has escalated in the past decade, but little is known about the recipients, the quantities prescribed, or the indications for prescribing.

Research Question: What are the indications and characteristics of patients prescribed opioid analgesics (OAs) from a national sample of discharged ED patients?

Methods: This retrospective cohort study examined a population from 19 hospital EDs with approximately 1.4 million annual adult ED visits over 1 week in October 2012. The hospitals varied geographically but were predominantly academic urban EDs. Reports listing all patients aged 18–90 years treated during the study week were generated, and visits in which the patient was discharged with an OA (excluding tramadol) were included for detailed analysis. A standardized chart review extracted information on demographics, clinical characteristics, and opioid prescription details. Descriptive statistics were generated.

Results: Overall, 27,516 patients were eligible. Of these, 19,367 (70.4 %) were discharged, 17.1 % (3,307 patients) of whom received an OA prescription. Of ED patients discharged with an OA, median age was 40 (interquartile range (IQR) 29–51)years; 1,713 (51.8 %) were female, and 2,271 (68.8 %) presented on a weekday. Mean Emergency Severity Index triage score was 3.3 (standard deviation (SD) 0.8). Mean initial pain score was 7.7 (SD 2.4). Allergies to non-opioid analgesics were reported

by 271 (8.2 %). Factors associated with receiving an OA were ages 35–64 years, male gender, being in the south and west geographic regions, white race, and first reported pain score >6 (Table). The most common opioids prescribed were oxycodone (n=1,714, 51.8 %), hydrocodone (n=1,346, 40.7 %), and codeine (n=168, 5.1 %). Of the formulations prescribed, >99 % (n=3,266) were immediate release; 90.2 % (n=2,968) were combination preparations, and the mean and median number of pills was 17.1 (SD 11.8) and 15 (IQR=12–20), respectively. The most common diagnoses associated with opioid prescription were musculoskeletal back pain, abdominal pain, and extremity fracture or sprain.

Discussion: The data complement studies which described prescribing but relied on extrapolation. Sixteen percent of OA are given, contrary to ACEP guidelines on clinical practice, for back and abdominal pain.

Conclusion: EDs prescribe OAs to 17 % of discharged patients but with small pill counts and predominantly immediate-release formulations.

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Table (Abstract 7). Risk factors associated with opioid analgesic prescribing

	N	%	RR (95 % CI)	
			Unadjusted	Adjusted[a]
Gender				
Female	10,199	16.7	Reference	Reference
Male	9,042	17.7	1.06 (0.99, 1.12)	1.12 (1.05, 1.19)
Region				
Northeast	11,045	14.8	Reference	Reference
Midwest	1,699	11.8	0.79 (0.69, 0.91)	1.06 (0.90, 1.25)
South	2,224	18.8	1.27 (1.15, 1.40)	2.17 (1.80, 2.60)
West	4,273	24.5	1.66 (1.55, 1.77)	1.13 (1.05, 1.21)
Race				
White	5,483	17.7	Reference	Reference
Black	3,837	13.9	0.79 (0.71, 0.86)	0.76 (0.69, 0.83)
Hispanic	1,627	17.5	0.99 (0.87, 1.11)	0.88 (0.79, 0.99)
Asian	524	13.0	0.73 (0.58, 0.91)	0.77 (0.61, 0.95)
Missing/Other	7,770	18.6	1.05 (0.97, 1.13)	1.20 (1.12, 1.30)

[a]Adjusted for all other variables in the table and age, emergency severity index score, day of week, and first reported pain score

8. Ambulatory Care and Emergency Department Prescribing Practices Do Not Account for Gender Differences in Opioid Analgesic-Related Deaths

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Background: Data from the National Vital Statistics System (1999–2010) reported a 400 % increase in deaths related to prescription opioid analgesics (OAs) in women, compared with 265 % in men. OA prescribing practices in US outpatient offices, clinics, and emergency departments (EDs) may affect overdose trends, but the relationship between the two has yet to be determined.

Research Question: Do gender differences in OA prescribing in outpatient offices, clinics, and EDs correlate with trends in OA-related overdose deaths in women?

Methods: A retrospective review of the CDC's National Ambulatory Medical Care Survey (NAMCS) 2001–2010 and the National Hospital Ambulatory Medical Care Survey (NHAMCS) 2005–2010 was performed. All adult ambulatory care and ED visits during which an OA was prescribed were included. Benzodiazepine co-prescribing was also examined, as this practice has been associated with OA-related deaths. The proportion of visits during which an OA was prescribed was tabulated and trends analyzed using survey-weighted logistic regression.

Results: There were an estimated 7.6 billion ambulatory care visits and 741 million ED visits during the respective study periods. OA prescriptions in the ambulatory care setting increased 88.0 % in women from 3.0 to 5.2 %, p=0.001. ED prescriptions for OAs increased 21.5 % in women from 7.6 to 9.2 % of visits (p=0.018). Although similar increases in OA prescribing were found in men, no statistically significant gender differences in OA prescribing were found (Table). The most common OA prescribed in both settings was hydrocodone followed by oxycodone. Co-prescribing of benzodiazepines remained stable in women in both settings.

Discussion: The percentage increase of OA prescriptions in women was similar to the increase found in men. The greater increase in OA-related overdose deaths in women seen from 1999 to 2010 cannot be attributed to increased prescribing rates alone. Factors yet to be determined, such as physiologic differences, or increased propensity for misuse and abuse, may be the underlying cause of the disproportion in OA-related deaths in women.

Conclusion: Increased rates of OA prescribing are not the sole cause of the greater percentage increase in OA-related deaths in women. Careful risk assessment and close monitoring by providers are important in mitigating rising mortality in women.

Table (Abstract 8) Gender differences in opioid prescribing patterns from 2001 to 2010, NHAMCS and NAMCS data

			2001	2005	2010	Percentage change	*P* value for gender difference
Percentage of visits with OA prescriptions	Ambulatory clinics	Women	3.0 %	3.9 %	5.2 %	73.3 %	0.637
		Men	3.1 %	4.3 %	6.0 %	93.5 %	
	Emergency departments	Women	–	7.6 %	9.2 %	21.5 %	0.322
		Men	–	7.5 %	8.6 %	14.7 %	

9. Cost-Effectiveness Analysis of Hemodialysis and Fomepizole Versus Fomepizole Alone in the Treatment of Toxic Alcohol Toxicity without Acidosis

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Background: Elevated concentrations of ethylene glycol (EG) and methanol can be managed with hemodialysis and/or enzymatic blockade in patients without acidosis or end-organ toxicity.
Research Question: Does hemodialysis and fomepizole versus fomepizole alone provide a cost-effective strategy for the management of patients with EG and methanol ingestions who do not have acidosis?
Methods: This is a cost analysis study based on charges assessed to 20 recent patients treated at a tertiary care hospital with fomepizole and/or hemodialysis. Cost of the room, hemodialysis, catheter, nephrology consult, fomepizole, and transport were obtained and averaged. Time required for hemodialysis was calculated based on the validated equation of Youssef GM (2005). This time was dependent on initial concentration, gender, height, weight, age, and dialysis machine. We assumed a patient would be dialyzed two times per day, 4 h each, and require three doses of fomepizole per 24 h while dialyzed. A half-life on fomepizole of 14.6 and 54 h for EG and methanol, respectively, was used to calculate total time needed for twice-a-day fomepizole dosing. Total cost of hospitalization was calculated and compared for hemodialysis (room, hemodialysis, catheter and placement, nephrology consult, fomepizole, possible transfer costs) versus fomepizole alone (inpatient room, fomepizole).
Results: EG costs were lower for all EG concentrations when comparing dialysis without transport to fomepizole alone (Table). Cost-savings were concentration-dependent—$24 at 50 mg/dL, $1951 at 100 mg/dL, and $8,005 at 400 mg/dL. With transport, fomepizole alone was more cost-effective for concentrations of 100 mg/dL and below. Methanol treatment costs were lower for all concentrations with dialysis regardless of transport costs (Table). Cost-savings were concentration-dependent—$12,146 at 50 mg/dL, $30,322 at 100 mg/dL, and $54,010 at 400 mg/dL. These savings were not significantly altered by transport costs.
Discussion: Limitations of the study include cost-calculations based on a single health system, inability to account for the risk of hemodialysis, or other hospital costs (e.g., psychiatric care).
Conclusion: Using validated hemodialysis (HD)-time predictions and real-world costs, hemodialysis was cost-effective for all EG concentrations not requiring transport and for EG concentrations above 100 mg/dL if the patient required significant (300 miles) transport. Hemodialysis was cost-effective in all cases of toxic methanol concentrations with or without transport.

Table (Abstract 9). Treatment cost (in dollars) of ethylene glycol (EG) and methanol with hemodialysis (HD) versus fomepizole alone with and without transport costs

Initial concentration (mg/dL)	EG cost (HD without transport)	EG cost (HD with 300-mile transport)	EG cost (fomepizole alone)	Methanol cost (HD without transport)	Methanol cost (HD with 300-mile transport)	Methanol costs (fomepizole alone)
50	$7,415	$9,982	$7,439	$10,171	$12,638	$22,317
100	10,171	12,638	12,122	11,556	14,023	41,878
150	11,556	14,023	14,878	14,312	16,779	52,073
200	11,556	14,023	19,561	14,312	16,779	56,756
250	14,312	16,780	19,561	14,312	16,779	64,195
300	14,312	16,780	19,561	14,312	16,779	66,951
400	14,312	16,780	22,317	20,380	22,847	74,390

10. Effects of Medical Toxicology Specialty Care on Resource Utilization During Hospitalization of the Poisoned Patient

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Background: The incidence of drug overdoses and poisonings has steadily increased over the past several years and is now the second leading cause of death for people aged 34–54 years. The benefits of care of patients with toxic exposures by medical toxicologists are intuitive, yet data demonstrating efficacy are lacking.
Hypothesis: We hypothesize that the presence of an inpatient medical toxicology service decreases resource utilization for hospitalized, poisoned patients.
Methods: This is a retrospective study of a cohort of poisoned patients discharged from two similar tertiary care hospital located 2 miles apart between January 1, 2008, and December 31, 2012. One hospital has an active inpatient medical toxicology service with a dedicated toxicology unit. The other hospital has no medical toxicologist on staff. A search of our hospital system's electronic medical record by an honest broker was used to identify all discharged poisoned patients utilizing ICD 9 codes. Inclusion criteria: all patients with primary discharge diagnosis of "overdose," "poisoning," or "toxicity" with ICD-9 codes 289, 304, 305, 503, 850–869, 930–952, and 960–989. Exclusion criteria: age<14 years old, prisoner, pregnant, admitted for withdrawal, admitted for alcohol intoxication, transfers, envenomations, and carbon monoxide toxicity. Subjects that met these criteria were grouped by whether they were treated by toxicologists versus those treated by non-toxicologists. R statistical package was used for data analysis. Chi-squared test was performed for categorical data. Non-parametric data were analyzed by Wilcoxon rank sum test. Medians and interquartile range were reported for continuous variables. The 95 % confidence intervals are reported for proportional variables.
Results: One thousand nine hundred seventy patients were identified, and 691 patients were excluded. Table shown summarizes the results.
Discussion: The non-toxicology service hospital has access to and may receive advice from medical toxicologist through the regional poison center which may minimize treatment differences.
Conclusion: The presence of an inpatient medical toxicology service decreases the use of medications and anesthesia related charges in hospitalized, poisoned patients.

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Table (Abstract 10)

	Toxicology service	Non-toxicology	*P* value
N	666	613	NA
ICU admits (%)	274 (41.1 [37.4–45.0])	253 (41.3 [37.4–45.3])	1
Age (years)	38 [28–51]	41 [30–51]	0.072
Male gender (%)	304 (45.6 [41.8.–49.5])	302 (49.2 [45.2–53.2])	0.215
No. of medication charges	18 [7,46]	29.5 [14, 65.25]	<0.001
No. X-ray charges	2 [2,5]	2 [2,4]	0.884
No. of lab charges	9 [3,26]	11 [4, 22]	0.391
No. of NAC charges	5 [4,6.5]	5 [4,6.75]	0.763
No. of anesthesia charges	6 [5.25, 10]	25.5 [18,48.5]	<0.001

11. The Rapid Growth of Drug-Overdose Deaths in Rural Counties from 1999 to 2012

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Background: Drug-overdose deaths (DOD) have been rising rapidly nationally in the US since the mid-1990s. Social, physical, and economical differences have been recognized as factors contributing to health differences between urban and rural communities. The aim of this study is to evaluate if a relationship exists between DOD and level of urbanization.
Hypothesis: We hypothesize that rural counties would experience a larger growth in DOD when compared with urban counties.
Methods: Utilizing data available for query by the Center for Disease Control, Wide-ranging Online Data for Epidemiologic Research (CDC WONDER), we analyzed DOD between 1999 and 2012. Cause of death is based upon death certificates and is classified by a corresponding ICD-10 code. Urbanization is based upon the 2006 National Center for Health Statistics (NCHS) Urban–rural Classification Scheme. Crude rate (CR) represents the number of DOD per 100,000 persons.
Results: Growth in CR was seen in all populations. In 1999, the CR of rural counties was less than that of urban counties (3.9 vs. 6.5). However, by the end of the study period, 2012, the CR of rural counties slightly exceeded that of urban counties (13.7 vs. 13.1). The rate of growth in CR was 1.5 times greater in rural counties over the study period (0.82/year vs. 0.56/year).
Discussion: These data suggest that, while the incidence of DOD increased for all populations, rural communities saw the largest growth. Multiple factors have been previously implicated in such trends: (1) economic stressors creating vulnerability to drug use; (2) greater community network and connections which may facilitate drug diversion and distribution; (3) lack of access to appropriate resources for drug rehabilitation. Causes of death are classified by the CDC by ICD-10 coding, and therefore, evaluating the incidence of specific drugs was not possible. Furthermore, urbanization is based on the 2006 NCHS classification scheme, and some counties may have crossed categories if populations significantly changed during the study period.
Conclusion: Analysis of DOD indicates that rural counties have been more heavily affected than more urban counties. Further efforts should be made to identify causes of such disparity so that solutions may be sought.

Table (Abstract 11). Crude rate of drug-overdose deaths for urban and rural counties, 1999–2012

Year	Urban counties (CR)	Rural counties (CR)	Year	Urban counties (CR)	Rural counties (CR)
1999	6.5	3.9	2006	11.6	11.2
2000	6.5	4.6	2007	12	11.9
2001	7.1	5.5	2008	12	12.2
2002	8.5	6.8	2009	12	12.6
2003	9.1	7.9	2010	12.3	13.1
2004	9.4	9.1	2011	13.1	14.3
2005	10.2	9.6	2012	13.1	13.7

12. Clinical Course and Outcomes Associated with Different Treatment Modalities for Pediatric Bark Scorpion Envenomation

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Background: In 2011, Centruroides (Scorpion) Immune F(ab') 2 (Equine) Injection (Anascorp®) (AV) was Food and Drug Administration (FDA)-approved for treatment of bark scorpion envenomation. The recommended initial dose is three vials with additional one-vial doses if symptoms persist. Antivenom cost led Phoenix Children's Hospital (PCH) to adopt guidelines for sequential single-vial dosing. Alternatively, some physicians provide only supportive care.
Research Question: Does treatment approach influence emergency department (ED) length of stay (LOS), hospital admission rate, and complications in children with Grade III or IV scorpion envenomation?
Methods: Retrospective chart review of all patients presenting to PCH ED between September 1, 2011 and March 31, 2014 with Grade III or IV scorpion envenomation. Patients were grouped by treatment: G1=no AV, G2=FDA dosing, G3=non-FDA dosing. ANOVA and Chi squared analysis were used for comparisons.
Results: One hundred fifty-six patients were included. Forty-two were grade 3; 114 were grade 4. Twenty-two percent had respiratory distress (RD). G1 had 58 patients (41 % grade 4, 3 % RD); G2 15 (87 % grade 4, 53 % RD); G3 83 (93 % grade 4, 29 % RD). Mean age G1=5.7 years, G2=2.5 years, G3=4.0 years (p=0.001). Time to presentation and ED LOS were not significantly different. Mean AV vials in G2=3.3; G3=1.8 (p<0.001). Hospitalization occurred in 3.4 % of G1, no G2 patients, and 8.5 % G3, but differences were not significant. There were two intubations and two aspirations, all in G3.
Discussion: PCH physicians may withhold AV or use variable dosing strategies. In this study, similar LOS across groups and low G1 admission rate suggest G1 patients were less ill than those receiving AV. Results suggest AV was reserved for sicker patients and 'FDA dosing' given to younger patients with RD. Although G3 had the most admissions and complications, numbers were too small in G2 to compare.
Conclusion: Treatment approach did not significantly affect outcomes in this study. Group differences in age, envenomation grade, and RD suggest that severity upon presentation influenced treatment. Sequential single-vial dosing appears reasonable, but further study needs to identify

the ideal population for this approach and determine whether such dosing leads to more complications.

Original Research: **Poster Presentation**

13. Intentional Pharmaceutical Overdoses Related to Therapeutic Misadventures: A Description of ToxIC Entries

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Background: Drug overdose due to intentional ingestion can be classified into three categories: attempt at self-harm (e.g., suicide), due to recreational misuse/abuse, or due to therapeutic misadventure. In 2014, the ACMT ToxIC Case Registry added these classifications to Intentional Pharmaceutical Poisonings. The ToxIC Registry includes all patients seen at the registered sites by a medical toxicologist.
Hypothesis: Cases of overdose due to therapeutic use would demonstrate a unique distribution of drug classes involved, but the distributions of severity and treatments given would be relatively normative with regard to all types of intentional overdose.
Methods: Retrospective review (1/2014–11/2014) of the ACMT ToxIC Case Registry analyzing data from the therapeutic use cases. Analysis was performed using descriptive statistics.
Results: Of 3,318 cases involving intentional pharmaceutical overdose, 375 cases with therapeutic use were identified. These cases were skewed toward the adult population (62 % 19–65 years and 26 %>65 years). Most cases (68 %) involved a single drug. The most common classes of drugs involved were cardiovascular medications (18 %), lithium (15 %), anticonvulsants (13 %), antidepressants (10 %), antipsychotics (10 %), and opioids (9 %). Overdose severity, as approximated by the number of organ systems/vital sign abnormalities involved, was positively skewed, with 64 % having one major clinical outcome, and 31 % with two or three organ systems involved, and 5 % with four to six organ system findings. With regard to the distribution of treatments given, 41 % received no treatment/support, 36 % received one treatment, 17 % received two treatments, and 6 % received three to four treatments. ToxIC toxidrome data were identified in 50 cases (13 %), with 20 (5 % total) diagnosed with serotonin syndrome and 12 (3 % total) an opioid toxidrome.
Discussion: The ToxIC Case Registry represents a novel mechanism for understanding the more severe types of poisonings that require medical toxicology consultation. Identifying the agents responsible and illness severity from exposure may inform prescribing and preventative practices may lead to decreases in this type of exposure in the future.
Conclusions: Data from the ToxIC Registry involving therapeutic use help characterize and understand the more severe type of intoxications associated with this type of ingestion.

14. Change in Provider Perspectives About Opioid Analgesics Following a Multidisciplinary Educational Intervention to Enhance Safe Opioid Use

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Background: Increased opioid prescribing is associated with rising addiction rates, overdoses, and deaths. Although several organizations have established guidelines to effect safe opioid prescribing by emergency department (ED) providers, it is unknown which aspects of provider perspectives are affected when prescribing changes.
Research Question: How does an ED-based educational intervention to decrease opioid prescribing affect ED providers' perspectives about pain management?
Methods: This prospective study measured the change in providers' perspectives following implementation of a previously reported, ED-based, multi-disciplinary educational intervention that improved the safety of ED opioid prescribing. The study population included ED nurses, nurse practitioners (NPs), residents, and attending physicians. Participants completed baseline and post-intervention web-based surveys measuring analgesic preferences and providers' responsibilities. The primary outcome was a change in perspectives measured in group means and assessed by *t* test. Secondary outcomes included changes in providers' views of ED pain management.
Results: One hundred eight (65.5 %) providers completed the baseline survey, and 91 (69 %) completed the (6-month) post-intervention survey. Respondents included nurses (42.8 %), attending physicians (22.6 %), resident physicians (30.1 %), and NPs (4.4 %); 32.5 % of respondents had practiced >10 years. Analgesics for acute pain shifted towards non-steroidal anti-inflammatory drugs (NSAIDs) and acetaminophen (p=0.012) and away from opioids for chronic pain (p=0.005). Providers increasingly identified the risks of short- and long-term opioid addiction (p=0.003, 0.0001, respectively). Providers acknowledged the potential exacerbation of opioid misuse secondary to the use of opioids for chronic pain and reported that ED providers can impact individual outcomes in pain management (see Table).
Discussion: Previously published data illustrate that educational interventions targeted at both prescribers and non-prescribing nurses decreased ED opioid prescribing. This follow-up study illustrates that safer ED opioid prescribing was accompanied by significant changes in provider perspectives on factors related to both acute and chronic ED pain management.
Conclusion: Pre- and post-intervention surveys assessing changes in provider's attitudes suggest that perspectives shifted about opioid analgesics, including increased emphasis on non-opioid analgesics and heightened awareness of the risk of opioid addiction. The educational intervention succeeded in changing perspectives, which may explain the success of the intervention.

Table (Abstract 14). Survey results

	Pre-intervention	Post-intervention	*t*test	*P* value
NSAIDs address acute pain	1.82	1.58	2.52	0.012
Acetaminophen addresses acute pain	2.10	1.83	2.55	0.012
Opioids address chronic pain	2.45	2.76	2.79	0.005
Opioids can be addictive in short term	2.40	1.76	5.50	0.000
Opioids given to improve patient flow	3.28	3.57	2.65	0.008
Opioids given to improve patient satisfaction	3.15	3.57	3.90	0.000
EDs may exacerbated opioid misuse by prescribing to patients with chronic pain	1.90	1.66	2.46	0.015
EDs may exacerbated opioid misuse by using IV opioids	2.34	2.09	2.35	0.019

All values indicate mean on Likert scale (1=strongly agree, 4=strongly disagree)

15. Refractory Hyperkalemia in a Patient with Normal Renal Function Treated with Hemodialysis

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Background: Severe hyperkalemia is common in patients with underlying renal disease but is rare in patients with normal renal function. Potassium chloride ingestion can cause severe hyperkalemia refractory to medical management.
Hypothesis: Medical management alone may be insufficient for treating severe hyperkalemia after potassium chloride ingestion.
Method: This is a single patient chart review. A 34-year-old female patient ingested 60 tablets of potassium chloride (20 meq) and presented to the emergency department 2 h later. Her mental status, vital signs, and physical examination were normal.
Results: Her renal function tests were normal (blood urea nitrogen, 11 mg/dL; serum Cr, 0.7 mg/dL). Her potassium level at 2 and 6 h post-ingestion was 7.7 and 8.8 meq/L, respectively. ECG revealed peaked T waves in the anterior leads. For the first 18 h, she was treated with kayexalate (three doses of 30 g PO), furosemide (two doses of 40 mg IV), calcium gluconate (three doses of 1 g IV), sodium bicarbonate (100 meq total), regular insulin and glucose (three doses of 10 units and 50 ml of 50 % dextrose IV). After 18 h, her serum potassium was 8.4 meq/L (serum creatinine unchanged). Hemodialysis was initiated for refractory hyperkalemia, and she was discharged 2 days later.
Discussion: We present a case of severe hyperkalemia in a patient with normal renal function secondary to potassium chloride ingestion, which was refractory to medical management. Patients with normal renal function typically maintain normal potassium levels. KCl ingestions present a unique challenge due to internal reservoirs and ongoing absorption of KCl salts in the gastrointestinal tract. Additionally, the effect of medical management is temporary and possibly insufficient: This patient was treated initially with conventional therapy; her serum potassium remained elevated despite having normal urine output and normal renal function. She then received hemodialysis.
Conclusion: Medical management of refractory hyperkalemia due to potassium chloride ingestion may be insufficient and temporary, so extracorporeal elimination should be considered early in these cases as severe hyperkalemia can cause life-threatening dysrhythmias and sudden cardiovascular collapse.

16. Bismuth Encephalopathy Masquerading as Hypernatremia and UTI

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Background: Bismuth encephalopathy is a rare manifestation of bismuth toxicity characterized by severe gradually evolving confusion, myoclonus, astasia–abasia, dysarthria, and/or other nonspecific neurologic symptoms such as hallucinations, paresthesias, and seizures.
Hypothesis: Signs and symptoms not correlating with a specific diagnosis should prompt further investigation.
Methods: This is a single patient chart review. A 74-year-old female with colitis and hyperlipidemia was sent from a nursing facility for confusion and tremors. She was diagnosed with a urinary tract infection (UTI) and hypernatremia. Her vital signs were normal, and her exam displayed hyperactivity, orientation only to self, resting tremors, myoclonus, ataxia, and choreatic movements. She did not have hyperreflexia or rigidity. The infection and sodium level were corrected, but the patient was still confused, tremulous, and had nonsensical speech. It was then discovered that she had been taking 1,050–2,100 mg of bismuth subsalicylate daily for the past 4 years.
Results: Her labs were remarkable for sodium 163 meq/L; chloride, 127 meq/L; magnesium, 3.4 mg/dL; blood urea nitrogen (BUN), 54 mg/dL; creatinine, 1.06 mg/dL; and a bismuth level of 327 mcg/L. On day 4 of admission, electrolytes, BUN, and creatinine had normalized, and the bismuth level was 197.5 mcg/L. Electroencephalogram and magnetic resonance imaging were unremarkable. On day 9 of admission, she was alert and coherent with minimal confusion but still displayed mild tremors and was discharged with loperamide to manage symptoms of colitis.
Discussion: This case illustrates elevated bismuth levels with therapeutic dosing of bismuth subsalicylate in a patient with colitis causing bismuth encephalopathy. Her initial presentation did not correlate with symptoms of hypernatremia, and further investigation was done. Background blood levels of bismuth in the general population is <50 mcg/L, but absolute concentrations correlate poorly with morbidity. Impairment of renal function may exacerbate bismuth-induced encephalopathy. Colitis patients may also be at higher risk for developing bismuth encephalopathy. This may be a point of public health awareness and clarification in packaging inserts.
Conclusion: The signs and symptoms in this case correlated significantly with bismuth encephalopathy, but was confounded by UTI and hypernatremia.

17. Cardiac Arrest and Prolonged Coma After Intentional Pentobarbital Overdose

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Background: Pentobarbital is considered a short-acting barbiturate ($t_{½}$ 4–50 h) only available as a parental formulation for human use in the United States, and thus, reports of human overdose are rare. However, oral formulation of pentobarbital is available online and used in veterinary medicine.
Hypothesis: Intentional overdose of pentobarbital can result in cardiopulmonary arrest and prolonged coma.
Methods: This is a single patient chart review. A 61-year-old male was brought in by ambulance after a cardiac arrest.
Results: The patient was found down in a hotel room pulseless and apneic after last being seen normal 12 h prior. On emergency medical service arrival, the patient was intubated and automated external defibrillation placed. The patient was defibrillated once, followed by two rounds of epinephrine and cardiopulmonary resuscitation with return of spontaneous circulation (ROSC). On arrival to the Emergency Department (ED), the patient's vital signs were: BP 107/94, HR 89 (irregular), RR 14 (intubated), 97 % bag valve mask, 27.5 °C (bladder temperature). An initial electrocardiogram showed atrial fibrillation without myocardial ischemia. Laboratory studies showed no metabolic disturbance, negative urine drug screen, and a normal computed tomography scan of the brain. The patient subsequently suffered a ventricular fibrillation arrest in the ED, required defibrillation three times at 200 J to achieve ROSC. Family members explained the patient had recently acquired 6.5 g of pentobarbital online. The patient required pressor support for persistent hypotension for 4 days and had a recorded Glasgow Coma Scale of 3, without sedation, until hospital day (HD) 6, requiring mechanical ventilation until HD 7. Serum pentobarbital level from HD 2 was 22.4 mcg/mL (reference range 20.0–50.0 mcg/mL preferred serum concentration for therapeutic coma), falling to 6.4 mcg/mL on HD 7 with supportive care alone. The patient recovered with a normal neurologic exam at discharge.
Discussion: Reports of patient intentional pentobarbital overdose is rare given that it is not available in an oral formulation for humans in the United States; however, it is available online. We report a case of a patient who suffered a cardiac arrest and coma, recovering with supportive care alone.

Conclusion: Overdose of pentobarbital may lead to cardiopulmonary collapse and prolonged coma.

18. Hepatotoxicity Associated with Use of a Dietary Supplement Containing Chinese Skullcap: A Case Report

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Background: The herb Chinese skullcap (*Scutellaria baicalensis*) is a member of the mint family containing multiple flavonoids including baicalin glycoside, wogonoside, baicalein, and wogonin. Despite its availability in a variety of over-the-counter anti-inflammatory preparations, few case reports have identified this supplement as a potential hepatotoxin.
Hypothesis: *S. baicalensis* is associated with hepatotoxicity.
Methods: This is a single patient chart review. A healthy 58-year-old man with a history of hyperlipidemia treated with simvastatin for more than 10 years presented to the Emergency Department with fever, chills, fatigue, and nausea 2 weeks after starting Safeway Care Glucosamine Chondroitin Complex Advanced/Triple Strength, a proprietary blend containing *S. baicalensis*.
Results: Vital signs on arrival were: BP 100/69, HR 98 bpm, RR 16, and O_2 sat 91 % on RA, T 97.7 °F. Abdominal exam revealed right upper quadrant tenderness to palpation with a negative Murphy sign and liver edge one to two fingerbreadths below the costal margin. Total bilirubin was elevated to 6.5 mg/dL, AST to 625 IU/L, (from 390 IU/L, from the patient's primary care provider's office 2 weeks earlier), ALT to 1,031 IU/L (from 822 IU/L, 2 weeks earlier), and alkaline phosphatase elevated to 390 IU/L (from 289 IU/L, 2 weeks earlier and 47 IU/L, 7 months earlier). During the course of the patient's hospitalization, a hepatitis viral panel was negative, acetaminophen, negative; and hepatic ultrasound, unremarkable. A liver biopsy showed a cholestatic hepatitis pattern with eosinophilic infiltration, suggestive of an adverse drug reaction. The patient's symptoms resolved, and the transaminases declined after cessation of medications. Samples of the supplement were sent to our laboratory where the flavonoids baicalin glycoside, wogonoside glycoside, baicalein, and wogonin were identified using a liquid chromatography/mass spectrometry method. The patient was not re-challenged with the medication.
Discussion: We report a case of a patient with drug-induced cholestatic hepatitis following the use of an over-the-counter supplement confirmed to contain the herb *S. baicalensis*. Given a calculated Naranjo score of 3, the patient's hepatotoxicity may be the result of the use of this supplement.
Conclusion: The use of dietary supplements containing *S. baicalensis* may be associated with hepatotoxicity.

19. Toxicological Ingestions Requiring Intubation: A Review of 13 years of NPDS Data

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Background: Toxicological exposure may result in decreased level of consciousness, decreased respiratory drive, seizure, ventilation/perfusion mismatch, or reduced diffusing capacity, resulting in the need for endotracheal intubation. There are little data on what ingestions are associated with the need for intubation.
Research Question: To determine which toxicological exposures most frequently required intubation.
Methods: A search of the National Poison Data System was performed for dates 1/1/2000–12/31/2013 using search criteria for 'human' exposures, requiring 'Intubation' as a therapeutic intervention, including 'performed' and 'recommended and performed' for single- and multiple-substance ingestions by age group: 0–5, 6–12, 13–19, and >19 years. A standardized spreadsheet and standard descriptive statistics were used to analyze the data.
Results: It was found that 93,474 single-substance exposures required intubation (Table). 52.3 % were males. The largest category (8.2 %) of exposures was miscellaneous/unknown. Most commonly intubated single exposures included: atypical antipsychotics 7.4 %, amitriptyline 6 %, and benzodiazepines 5.4 %. Some 228,507 multiple substance ingestions required intubation—27.4 % benzodiazepines, 17.2 % atypical antipsychotics, and 12.3 % ethanol. Under age 6 years, 5,517 patients were intubated for single ingestions: clonidine (15.5 %), carbamazepine (5.9 %), and miscellaneous unknown drugs (5.2 %); and 6,491 for multiple exposures: clonidine (16.2 %), carbamazepine (5.7 %), and miscellaneous unknown drugs (5.2 %).
For age group 6–23 years, 1,059 patients were intubated for single-substance exposures: miscellaneous unknown drugs (11.5 %), clonidine (7.3 %), carbon monoxide (64, 6.0 %); 1,445 for multi-substance exposures: atypical antipsychotics (10.4 %); miscellaneous unknown drugs (10.1 %); clonidine (7.3 %). For age group 13–19 years, 8,961 were intubated for single-substance exposures: miscellaneous unknown drug (8.5 %), atypical antipsychotics (7 %); and ethanol (6.8 %); and in 18,815 multi-substance exposures: atypical antipsychotics (16.4 %); benzodiazepines (14.6 %); and ethanol (12.5 %);
In those over age 19 years, 76,235 were intubated for single ingestions: miscellaneous unknown drugs (8.4 %); atypical antipsychotics (7.8 %); amitriptyline (6.3 %); 198,152 with multiple substance exposures: benzodiazepines (29.6 %), atypical antipsychotics (17.8 %), and ethanol (17.5 %).
Discussion: Atypical antipsychotics were the most frequent single exposure requiring intubation while benzodiazepines were implicated most frequently in multi-ingestions. The most common single exposures associated with intubation in children were clonidine and carbamazepine in the age less than 13 years group, and atypical antipsychotics in age over 13 years group.

Table (Abstract 19). Single exposures requiring intubation by age group (*Y*=years; < less than, > greater than)

Age group	Atypical antipsychotic	Amitriptyline	Benzodiazepine	Ethanol (beverage)	Carbamazepine	Clonidine	Carbon monoxide	Total
All	6,914	5,627	5,036	2,370	1,322	1,280	1,211	93,474
<6 Y	142	53	58	37	326	856	95	5,517
6–12 Y	56	60	23	21	47	77	64	1,059
13–19 Y	623	590	227	612	199	60	58	8,961
>19 Y	5,980	4,815	4,605	1,665	741	284	949	76,235

20. Intravenous Fat Emulsion Does Not Significantly Alter Clotting Markers in Dabigatran-Treated Blood

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Background: Dabigatran etexilate is an oral direct thrombin (factor IIa) inhibitor that is Food and Drug Administration-approved to reduce the risk of stroke and systemic embolism in patients with non-valvular atrial fibrillation and for the treatment and reduction of risk of deep vein thrombosis (DVT) and pulmonary embolism. Dabigatran offers several advantages over traditional treatment with warfarin, including but not limited to no routine laboratory monitoring. It has been shown to be equivalent in prevention of stroke and DVT with similar bleeding rates. Hemodialysis has been proposed as a method of reversal, but unfortunately there is no known reversal method appropriate for use in patients with emergent life-threatening hemorrhage. Intravenous fat emulsion (IFE) has been used in the treatment of overdose of lipophilic drugs. Most toxicologists only recommend IFE for patients in extremis after ingestion of a lipid soluble substance. Dabigatran is lipid-soluble, particularly in pro-drug form.
Research Question: Will IFE treatment correct in vitro dabigatran-induced coagulopathy of human blood samples?
Methods: Blood draws from healthy volunteers were spiked with dabigatran or dabigatran plus IFE. Values for Ecarin clot time (ECT), international normalized ratio (INR), and activated partial thromboplastin time (aPTT) were compared across both study arms. Data were analyzed using paired *t* tests.
Results: The study included 18 healthy volunteers. Addition of dabigatran caused a marked increase in ECT, INR, and PTT compared with untreated and samples treated only with IFE. There was no significant difference in the ECT between the dabigatran and dabigatran+IFE arms (see table). INR and aPTT were statistically significantly different between the two arms.
Discussion: In vitro addition of IFE to dabigatran-treated samples did not significantly alter the ECT. The small decreases in INR and aPPT were statistically significant but unlikely to be clinically relevant. These data suggest IFE may not successfully reverse the effects of dabigatran. The major limitation of these studies is their in vitro nature.
Conclusion: IFE does not reverse in vitro dabigatran-induced coagulopathy.

Table (Abstract 20)

Increase in coagulation time: adding lipids to dabigatran

	Clotting time mean (SD)		Estimated change (using paired *t* tests)	
	Dabigatran	Dabigatran+ lipid	Mean (SE)	*p* value
Immediate				
ECT (primary outcome)	123.2 (3.5)	123.7 (3.2)	0.45 (0.38)	Not significant
INR	1.49 (0.12)	1.47 (0.12)	−0.01 (0.004)	0.004
aPTT	52.5 (3.9)	52.9 (4.1)	0.37 (0.16)	0.04

21. Outcomes Following Mechanical Ventilation of Salicylate-Poisoned Patients

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Background: Salicylate (SAL) poisoning, alone, may result in coma and respiratory failure (RF) leading to need for mechanical ventilation (MV), with contribution by co-ingestants. There is a belief among some physicians that MV may be avoided in SAL poisoning since intubation and MV may culminate in acute deterioration and death from rise in PCO2 and fall in arterial pH, with movement of SAL from blood into brain and other organs. To our knowledge, there are no published data on outcomes following MV of SAL-poisoned patients to support this claim. We examined our experience in treating SAL-poisoned patients who underwent MV.
Research Question: What clinic outcomes are associated with MV and SAL poisoning?
Methods: A retrospective chart review was performed from 1/1/2004 to 12/31/2013. Patients with SAL poisoning were identified via ICD-9 codes and toxicology patient registries. SAL poisoning was defined as a peak serum SAL level >20 mg/dL. Mild–moderate (M-M) poisoning was 20–50 mg/dL, and moderate–severe (M-S) poisoning was >50 mg/dL. Hypotension was defined as a systolic blood pressure <100 mmHg. An arterial pH <7.35 was considered acidemic.
Results: Two hundred sixty-three patients were identified with SAL poisoning, of which 39 were placed on MV. Ages ranged from 15 to 82 years. The 16/39 had M-M poisoning (20.5–48.3 mg/dL), and 23/39 had M-S poisoning (50.5–101.7 mg/dL). Some 5/39 had isolated SAL poisoning; 24/39 co-ingested psychoactive drugs and/or respiratory depressants. 10/39 were intubated for agitation and 29/39 for RF/coma. Five were acidemic, and 21/39 had unknown acid–base status prior to MV. The 16/39 were acidemic following MV with two unknown. Some 18/39 received $NaHCO_3$ infusions prior to MV with two unknown. 18/39 had hypotension, with 13/18 requiring vasopressors while 12/18 developed hypotension following MV with 9/12 having M-S poisoning. The 13/39 underwent hemodialysis to remove SAL. No deaths, cardiac arrests, or seizures occurred, and all patients made complete recoveries.
Discussion: At our center, we closely monitor and adjust arterial pH to correct acidemia and maintain alkalemia during and after intubation. Our data suggest that SAL-poisoned patients can be mechanically ventilated with good outcomes when care is taken to prevent falls in arterial pH.
Conclusion: Hypotension was the most serious event associated with MV.

22. Academic Rank of Board Certified Medical Toxicologists in U.S. Medical Schools

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Background: Medical toxicology is a growing specialty within the United States (U.S.). The academic rank of board-certified (BC) medical toxicologists affiliated with U.S. medical schools has not been previously reported.
Research Question: The purpose of this study is to describe the academic rank of BC medical toxicologists in the U.S.
Methods: A listing of BC medical toxicologists in the U.S. was obtained from the American Board of Medical Specialties and American Board of Medical Toxicology databases. Each medical toxicologist was entered into the Association of American Medical Colleges (AAMC) Medical School Faculty Online Directory, which includes full time faculty only. Affiliation and academic rank of each medical toxicologist were identified. Academic rankings of other BC medical toxicologists were identified through university websites.
Results: Some 217 of 462 (47 %) BC medical toxicologists were found to have an academic rank in the AAMC Medical School Faculty Online database. 4/217 (2 %) are instructors; 91/217 (42 %) are assistant

professors; 54/217 (25 %) are associate professors; 66/217 (30 %) are professors; and 2/217 (1 %) are listed as "other."
A search of medical school websites identified additional 88 BC medical toxicologists who hold an academic appointment but were not listed in the AAMC database. Of these, 6/88 (7 %) are instructors; 34/88 (39 %) are assistant professors; 30/88 (34 %) are associate professors; and 18/88 (20 %) are professors.
Between the AAMC database and medical school websites, we identified 305 BC medical toxicologists with a medical school academic rank. The 10/305 (3 %) are instructors; 125/305 (41 %) are assistant professors; 84/305 (28 %) are associate professors; and 84/305 (28 %) are professors. Of the 462 BC medical toxicologists in the U.S., 305 (66 %) hold an academic rank.
Discussion: A large proportion of board-certified toxicologists hold academic ranks at U.S. medical schools. However, this does not imply they are teaching or practicing medical toxicology, and some may be solely focused on emergency medicine. Retired BC medical toxicologists may also account for some who are BC but without academic rank.
Conclusion: Three hundred five (66 %) of the board-certified medical toxicologists in the U.S. hold an academic rank, of which 84 (28 %) are full professors.

23. Characterization of Acute Opioid Overdose in the ToxIC Registry

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Background: The abuse and misuse of prescription opioid analgesics in the United States has steeply risen over the past decade. Trends among gender differences and age groups are described in National Survey data; however, it is self-reported and only includes intentional abuse.
Objective: To compare characteristics of patients reported in the ToxIC database following opioid overdose.
Methods: This is a retrospective review of opioid overdoses reported to the ToxIC database. All intentional and unintentional pharmaceutical encounters between 1/1/10 and 11/1/14 were reviewed. All cases that listed opioids as a primary agent in the ingestion were included for analysis.
Results: Four thousand eight hundred eighteen cases were classified as intentional and 696 cases as unintentional pharmaceutical encounters. Opioids were listed as the primary agent in 553 (11 %) of intentional and 58 (8 %) of unintentional cases. In the intentional group, the top five agents were oxycodone (148 cases, 27 %), methadone (91, 16 %), hydrocodone (80, 14 %), tramadol (80, 14 %), and heroin (41, 7 %). Of the unintentional overdoses, the most common agents were buprenorphine (16 cases, 28 %), oxycodone (12, 21 %), methadone (9, 15 %), morphine (6, 10 %), and tramadol (5, 9 %). Naloxone was administered to 26 patients in the unintentional category and 203 in the intentional overdose category (44.8 % versus 36.7 % $p=0.22$). Men accounted for 305/611 (50 %) and women for 306/611 (50 %) of opioid encounters overall. The 279 (50 %) of intentional cases were males, and 274 (50 %) were females. For unintentional overdoses, males accounted for 26 (45 %) and females 32 (55 %) of cases. The number of intentional versus unintentional encounters by age group is listed in the Table.
Discussion: The most common opioid encountered in overdose was oxycodone (26 % of all cases). There was no significant difference in naloxone use between intentional and unintentional overdoses in this dataset. More than half of unintentional overdoses occurred in patients 6 years old and under (34/58, 59 %); this emphasizes the importance of overdose prevention targeted towards this age group.
Conclusion: Opioid overdose reported in the ToxIC database provides important details including types of pharmaceuticals, user demographics and intent, and need for treatment. This information can be used to target at risk populations for prevention programs.

Table (Abstract 23). Number of opioid overdoses by age (years) and intent

	<2	2–6	7–12	13–18	19–65	66–89	>89	Unknown
Unintentional	17	17	1	1	19	3	0	0
Intentional	1	4	3	61	451	31	1	1

24. Characteristics and Treatments of Patients with ECG Findings Significant for QRS Widening

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Background: Many xenobiotics may cause QRS prolongation on the ECG which can result in significant morbidity and mortality. The objective of this study is to describe the characteristics and treatment of single exposure cases of QRS prolongation in the ToxIC registry.
Hypothesis: QRS prolongation is associated with multiple different agents and significant morbidity.
Methods: Using the ToxIC Registry, cases with QRS prolongation greater than 120 ms were selected from January 1–September 1, 2014. Cases were limited to single substance exposures.
Results: Thirty-six cases were abstracted. Ages were in years: 13–18 (4); 19–65 (26); 66–89 (5); and unknown (1). Fifteen were female; 21 were male. There was one death of an unknown ingestion. The drugs reported were (number of cases are in parentheses): amitriptyline (9), beta-blocker (1); bupropion (2); carisoprodol (1); crack cocaine (1); desipramine (1); dextromethorphan (1); digoxin (1); diphenhydramine (5); ethanol (4); flecainide (1); heroin (2); imipramine (1); mirtazapine (1); propofol (1); propranolol (1); quetiapine (1); unknown (1); and venlafaxine (1). Cardiovascular signs described were: tachycardia (9), hypotension (10), bradycardia (3), QTc prolongation (15), ventricular dysrhythmias (3), and greater than first-degree block (4). Significant neurological signs included: coma/CNS depression (20), seizures (8), agitation (5), and delirium/toxic psychosis (4). Key treatments were as follows: sodium bicarbonate (21), lipid (5), calcium (2), benzodiazepines (11), vasopressors (6), beta-blockers (2), anticonvulsants (1), THAM (1), and hypertonic saline (1). Additional therapies included: CPR (2), ECMO (1), hemodialysis (1), and transcutaneous pacing (1).
Discussion: A large percentage of cases represented were cyclic antidepressants and drugs less known to cause QRS prolongation. QRS prolongation was associated with coma (55.5 %) and seizures (22.2 %). Treatment involved sodium bicarbonate in 58.3 % and lipid in 13.9 % of cases. THAM and hypertonic saline were used in one case. Limitations include unreported co-ingestants and limited availability of confirmatory laboratory testing.
Conclusions: QRS prolongation is associated with multiple different medications and with significant cardiovascular and neurological toxicity. Sodium bicarbonate was used in only just over half the cases. Currently, there are no accepted criteria for its use. Future studies should be aimed at validated criteria for bicarbonate treatment of QRS prolongation.

25. Piperidine and Piperazine Substructures are a Common Feature of Drugs Labeled for QT Prolongation

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Background: QT Prolongation (QTP) is used as a surrogate for drug-induced Torsade de Pointes (TdP), a serious and usually fatal ventricular arrhythmia. QTP has been noted for a variety of different drug classes. Because TdP tends to be a rare event and difficult to confirm without electrocardiographic monitoring, identifying possible toxicophores

associated with QTP could be useful in strengthening safety signals and identifying the need for additional studies.
Hypothesis: Structural analyses and similarity searches may identify drugs that warrant further QTP assessments.
Methods: Food and Drug Administration (FDA) drug products were searched using natural language processing to identify drugs with QTP in the Warnings and Precautions sections. The structural features of these drugs were reviewed and a chemical substructure search performed to identify launched or withdrawn drugs that shared a common structural feature.
Results: A search of FDA drug labels performed August 2013 identified 48 drugs (excluding arsenic) that were labeled in the Warnings and Precautions sections for QTP. Most drugs were amines (44 tertiary), with a majority of these being cyclic amines (33). Among the cyclic amines, 8 piperidines and 11 piperazines were identified. The substructure search for piperidines generated a list of 215 drugs, including 19 opioid compounds (n=19, one labeled). A piperazine search generated a list of 123 drugs that included a prevalence of antidepressants/antipsychotics (n=32, 8 labeled).
Discussion: Many TdP FDA Adverse Event Reporting System (FAERS) case reports are confounded by the presence of multiple QTP drugs taken in combination or overdose, making it difficult to identify the primary drug. It is possible that multiple QTP drugs may act synergistically. Therefore, it is possible that older opioids and antipsychotics may have unrecognized QTP liabilities. A preliminary review of the FAERS databases revealed reports of QTP or TdP for several of the unlabeled opioids and first-generation antipsychotics identified in the search.
Conclusion: A substructure analysis of approved drugs labeled for QTP noted the prevalence of nitrogenous ring- and tertiary amine-based structures including piperidines and piperazines. Further analysis of possible safety signals associated with opioids and antipsychotics currently not labelled for QTP may be warranted.

26. Bupropion: An Atypical Cause of Serotonin Syndrome Report from the ToxIC Registry

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Background: Bupropion, an atypical antidepressant, has an unusual mechanism of action that includes reuptake inhibition of dopamine and norepinephrine but negligible effects on serotonin neurotransmission. There is debate about whether bupropion can lead to the serotonin syndrome. Case reports describe serotonin syndrome associated with bupropion in combination with other serotonergic agents. We sought to describe the patients with serotonin syndrome in association with bupropion as reported to the Toxicology Investigators' Consortium (ToxIC).
Methods: We accessed the ToxIC registry for cases in which "Serotonin Syndrome" was identified among the patient's signs/symptoms (from a drop-down menu) and for which bupropion was identified as a primary agent. The ToxIC registry was established in 2010 and is a multicenter prospective database of cases that were evaluated and treated by a medical toxicologist.
Results: There were 67 cases identified, 29 (43 %) male, with the majority of patients (n=50, 75 %) in the 19–65 year age group. There were 16 cases (24 %) under 18 years of age. The circumstances of exposure were Intentional (75 %), Unintentional (7 %), Adverse Drug Reaction or Effect (15 %), Unknown or Drug Abuse (1 patient each). In eight cases, bupropion was the only responsible agent listed. The most common agents listed in conjunction with bupropion were citalopram (n=9) venlafaxine (8), and sertraline (6). The most common classes involved were antidepressants. Symptoms, where reported, included hyperreflexia/clonus/myoclonus or tremor (69 %), delirium or agitation (58 %), tachycardia (51 %), and seizures (28 %). Benzodiazepines were listed as treatment in 66 % of cases; 12 % of cases listed cyproheptadine.
Discussion: Bupropion is thought to have a negligible effect on serotonergic neurotransmission; this series further illustrates what previous case reports have described: Bupropion may be a causative agent for serotonin syndrome. This is substantiated by cases in which bupropion was the sole agent listed. Bupropion does appear to be associated with the serotonin syndrome, both in the case of intentional overdose as well as adverse drug effects.
Conclusion: Avoidance of other serotonergic agents, in particular antidepressants, may be prudent in patients on bupropion. Moreover, the diagnosis is plausible in a patient with suspected bupropion exposure and signs of serotonin excess.

27. 24/7 Bedside Toxicology Service

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Introduction: The establishment of a full-time bedside toxicology consultation service offers many benefits to an institution. However, establishing administrative and salary support for this endeavor requires an understanding of projected volume, sources of referral, and indications for consultation beyond the acute overdose.
Objective: We describe our experience in the first year offering a 24/7 full-time consultation service.
Methods: Database review of toxicology service at a tertiary community hospital setting with 600 inpatient beds, a Children's Hospital, and annual ED volume 85,000. Beginning October 2013, three board-certified medical toxicologists were available at all times by phone and for bedside consultation. Volume-based financial support was provided by Department of Emergency Medicine. There were no trainees, and all clinical duties were performed directly by the medical toxicologists; only ED and inpatient consultations were offered as outpatient services had not yet been established.
Results: There were 201 patients/initial consults and 144 follow-up visits. Encounter volume rose from 0.67/day in month 1 to 1.03/day in month 12 (range 0.35–1.35); average 28.7 (range 10–42) per month. Patient data: average age 36.3 years (median, 36 years; range, 12 months to 88 years), 52 % female. The primary reason for encounter was intentional (70 %), unintentional (12.4 %), organ system dysfunction (7 %), and withdrawal (3 %). The 14 % of cases involved an adverse drug reaction. Referrals came primarily from the ED (83 %) and some from the admitting service (13 %), and initial consult location was ED (61.1 %), inpatient floor (20.8 %), and intensive care unit (35.8 %).
Discussion: We observed a steady increase throughout the first year and varied indications for consult. Although clinicians commonly envision a toxicologist consulting in acute overdose scenarios, we saw a significant proportion of patients with other indications including adverse drug reactions. These cases became more frequent as the service matured.
Conclusion: A bedside toxicology service will grow with awareness of the service and indications for consultation. Volume and referral patterns reported in our experience can be expected in similarly sized and staffed institutions. Future directions include establishment of outpatient services and diversifying referral sources via educational, academic, and administrative collaboration with other departments.

28. Features of Synthetic Cannabinoid Exposures: Report from the ToxIC Registry

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Background: Synthetic cannabinoid (SC) exposures often prompt ED visits and toxicology consultation. This is presumably due to clinical

effects uncommon to traditional marijuana (*Cannabis sativa*) including seizures, agitated delirium, and myocardial ischemia.
Objective: We sought to examine the features of SC exposures reported to the ToxIC registry, including demographics, street names, routes of exposure, and clinical effects.
Methods: All cases entered into ToxIC from 2011 to October 2014 selected as "Bath Salt, Synthetic Cannabinoid, other Designer Drug, or Agent referred to by a Street Name" were then sorted to identify SC cases. Non-SC and unknown exposures were excluded. Data were reviewed for the features below.
Results: One hundred eight cases total, average age 27.1 years (SD 11.6; range, 14–59), 86 % male. Most common street name mentions: "K2" (n=36), "spice" (n=17), "black mamba" (n=12), and "crazy monkey" (n=6). When route listed (55 cases) the majority were inhalation (92 %, 2 % oral). Most common clinical effects reported were agitation (n=36, 33.3 %), coma/CNS depression (n=14, 13 %), delirium/psychosis (n=8, 7.4 %), acute kidney injury (n=6, 5.5 %), respiratory depression (n=6, 5.5 %), and seizure (n=5, 4.6 %).
Discussion: Synthetic cannabinoid receptor agonists are relatively new compounds that have significant recreational abuse popularity. In this cohort, young males with inhalation exposure were by far the most common. Although these exposures were not confirmed by laboratory analysis, the nature of this database (cases seen and entered by a medical toxicologist directly caring for the patient) increases the likelihood of accurate reporting. These compounds have widely varied content, leading to unpredictable clinical effects atypical of *C. sativa*, including those listed above.
Conclusion: In this study, young males were the most likely to use SCs which are sold under a variety of street names, and inhalation was the most common route by far. Clinical features differ from those seen with marijuana and may be life-threatening. Clinicians caring for these patients should be alert to this broader spectrum of effect.

29. Characterization of Edible Marijuana Product Exposures Reported to the National Poison Data System

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Background: Edible marijuana products are sold as brownies, cookies, candies, lollipops, and flavored drinks. Many look like their regular counterparts and are palatable to children and adults. Edibles unit packages may contain multiple "servings" (doses) requiring portion control. The consumption of an entire product may result in overdose even for seasoned users and may be life-threatening in children.
Research Question: Characterize edible marijuana exposures.
Methods: We queried human single-substance exposures coded to marijuana brownies, candies, cookies, beverages, or other foods reported to the National Poison Data System (NPDS) from January 2013 to August 2014. Cases were analyzed by state, exposure route, age, gender, clinical effect, therapies, and level of health care facility care.
Results: One hundred fifty cases were reported: Colorado (n=71, 49 %) and Washington (n=29, 20 %) yielded the highest number of exposures. One hundred forty-seven (98 %) were ingestions, and 75 (50 %) were male. The most common age groups were: ≤ 5 years (n=33, 24 %), 13–19 years (n=26, 19 %), and 20–29 years (23, 17 %). The most frequent clinical effects were drowsiness/lethargy (n=65, 19 %), tachycardia (n=33, 10 %), vomiting (n=26, 7.5 %), confusion (n=25, 7.2 %), and agitated/irritable (n=19, 5.5 %). The most common therapies were intravenous fluids (n=26, 17 %), benzodiazepines (n=12, 8 %), and dilute/irrigate/wash (n=11, 7.3 %). Three cases required intubation in patients ages 4, 10, and 57 years. Seventy-five cases (66 %) were treated and released. Four cases (3.5 %) required critical care unit admission.
Discussion: The exposures to children ≤5 years and teenagers may be attributable to increased availability and palatability of edibles. Decriminalization of recreational marijuana use in Colorado and Washington lead to a substantial increase in exposures compared with other states. The number of exposures may increase as other areas (Alaska, Oregon, and Washington D.C.) recently voted to decriminalize recreational marijuana. Limitations include passive reporting to the NPDS and the lack of dosing information. Further subgroup analysis may show differential effects for children less than five as compared with adolescents and adults.
Conclusion: The most common effect was drowsiness/lethargy, and three cases required ventilatory support. Edible marijuana exposures were more common in states with decriminalized recreational marijuana.

30. Characterization of Medical Marijuana Product Exposures Reported to the National Poison Data System

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Background: Since 1998, 23 states have enacted laws allowing distribution of medical marijuana. Most forms are tetrahydrocannabinol (dronabinol), cannabidiol, and nabilone (a synthetic cannabinoid). These compounds are administered as tablets, oils, and edible products. Adverse effects related specifically to medical marijuana products have not been well characterized.
Research Question: Characterize medical marijuana exposures.
Methods: We queried human single-substance exposures coded to medical marijuana, dronabinol, cannabidiol, dronabinol/cannabidiol combinations, nabilone, and associated branded products reported to the National Poison Data System (NPDS) from January 2012 to August 2014. Cases were analyzed by state, product, exposure route, age, gender, exposure reason, clinical effect, therapies, and level of health care facility care.
Results: Ninety-eight cases were reported. The most common locations were Washington (n=10, 10 %), New York (n=9, 9 %), California (n=8, 8 %), and Michigan (n=8, 8 %). States with medical marijuana laws accounted for 51 cases (52 %). 93 (95 %) were ingestions, and 42 (43 %) were male. Forty exposures (41 %) were unintentional. The most common age groups were: ≤ 5 years (n=28, 29 %), 20–29 years (n=16, 16 %), and 13–19 years (n=14, 14 %). Most frequent clinical effects were drowsiness/lethargy (n=29, 30 %), confusion (n=13, 13 %), tachycardia (n=11, 11 %), dizziness/vertigo (n=10, 10 %), and nausea (n=7, 7 %). The most common therapies were intravenous fluids (n=12, 12 %), single-dose charcoal (n=4, 4 %), and benzodiazepines (n=3, 3 %). Only one case required intubation—12-month-old child who ingested 20 mg of dronabinol. Forty-nine cases (50 %) were treated and released. Fourteen cases (14 %) required critical care unit admission.
Discussion: Despite only being approved in 23 states, the remaining states accounted for 48 % of exposures. The majority of exposures occurred in ages not typically associated with illnesses with indications for medical marijuana treatment. Although cannabidiol has been used for childhood epilepsy, no current Food and Drug Administration indication exists. Pediatric exposures were likely unintentional exploratory exposures or intentional misuse. Clinical effects were consistent with the known marijuana intoxication profile. The study was limited by passive reporting to NPDS.
Conclusion: Most exposures occurred in patients ≤30 years old and in states with medical marijuana laws. Severe drowsiness/lethargy, although rare, can occur in children.

31. Intravenous Lipid Emulsion Does Not Resuscitate Cocaine Induced Cardiovascular Arrest in a Rat Model

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Background: Cocaine use and overdose can precipitate dangerous cardiac dysrhythmias. Because of its lipid-soluble nature, the use of intravenous lipid emulsion (ILE) has been suggested as a potential antidote in the setting of cardiovascular collapse from cocaine use.
Research Question: To determine if ILE administration would resuscitate rats from cocaine-induced cardiovascular collapse.
Methods: This was a randomized controlled trial of 12 male Sprague–Dawley rats that were pre-cannualized with arterial and venous catheters and induced with isoflurane. Cocaine was given intravenously in a 10-mg/kg bolus to nine rats and in a 5-mg/kg bolus in equivalent volume to three rats. All rats experienced cardiac arrest. Closed chest compressions (CPR) was immediately performed, and a 10-mg/kg bolus of ILE was given through slow infusion over 7 min. In three of the rats, an equivalent bolus of normal saline was given in place of ILE. Compressions were continued for 15 min with intermittent 2-s pauses to check for a perfusing cardiac rhythm. At the end of the study, rats were euthanized.
Results: All rats had normal vital signs prior to cocaine bolus. All animals had immediate cardiovascular collapse after cocaine administration, and of those that received full dose of ILE, no rats survived. Despite CPR and ILE, no rats could be resuscitated.
Discussion: Cocaine-induced cardiovascular collapse currently has no antidote. Case reports have shown efficacy in few human trials. Our study suggests that ILE may not be an antidote for cocaine-induced cardiovascular collapse.
Conclusion: ILE was not effective in reversing cocaine-induced cardiovascular collapse in this rat model.

32. Correlating Physical Exam Findings on Poisoned Patients Through Google Glass

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Background: Toxicologists help assess poisoned patients to determine correct antidotes and management strategies. A simple head-mounted device can effectively link a toxicologist to a virtual bedside evaluation of the poisoned patient.
Research Question: To determine the feasibility and efficacy of Google Glass to evaluate the poisoned patient.
Methods: This is a prospective descriptive study. After training to use Glass, Emergency Medicine residents rotating on the toxicology would receive verbal reports of new toxicology consults. Before seeing the patient, residents would complete a survey regarding information gleaned from the case. Next, the resident examined the patient at the bedside while wearing Glass. Using a HIPAA compliant software on a modified version of Google Glass (Pristine IO, Austin TX), the attending viewed the consult remotely and provided guidance to the resident. Residents obtained static photos of pertinent findings through Glass. Residents then completed a survey regarding feasibility and connectivity of Glass was completed at the end of the consult.
Results: Six patients were assessed through Glass. Video feed was stable during all consults, and audio was clear without interruptions. Users experienced minor lag of video feed. All users preferred Glass to traditional video camera feeds. Antidote (naloxone) was recommended for one patient, while management changed in five of six patients. Use of Glass increased the confidence of users in identification of toxidrome.
Discussion: Google Glass can augment recognition of the poisoned patient. It has the potential to extend the reach of toxicologists to hospitals where no specialized toxicology consult exists. The visual component of Glass increased confidence among users. Further studies will be needed to investigate cost effectiveness and advanced triage abilities of Glass.
Conclusion: A wearable head-mounted device can be used to provide real-time feedback and help in identifying toxidromes in poisoned patients.

Table (Abstract 32)

Characteristic	Agree (n=6)	Disagree (n=6)
Needed to prompt for additional information over phone tox consult	4 (66 %)	2 (33 %)
Confident in diagnosis after Google Glass consult	6 (100 %)	0 (0 %)
Glass changed my management of the patient	5 (83 %)	1 (17 %)
Strong audio/visual connection during consult	4 (66 %)	2 (33 %)

33. Estimating Nonmedical Use of Prescription Opioids in the United States from Social Media

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Objectives: The non-medical use of prescription drugs (NMUPD) is a significant public health burden that affects users, their families, their peers, and society at large. Social media provide data that may help us understand NMUPD in the general population.
Research Question: Can the point prevalence of opioid NMUPD be accurately and rapidly estimated by publicly available data from Twitter?
Methods: This cross-sectional study of the point prevalence of opioid NMUPD used publicly available data from the Twitter API. Institutional Review Board approval was obtained at the authors' institution. We clustered tweets using a novel measure of semantic similarity that we developed that accounts for context. We used the silhouette coefficient to automatically determine the most likely number of clusters in the data. To geolocate the tweet, we used latitude and longitude coordinates in the metadata of the tweet. Since only 1–2 % of tweets contain explicit information, we used Carmen—a program that infers location from the text and metadata of a tweet—to approximate the location of more tweets. From these data, we calculated the location quotient for each state in the continental US. We validated our estimate by calculating its correlation with the location quotient calculated from the 2012 National Survey on Drug Use and Health as well as controlling for US population density.
Results: We obtained 106,422 tweets over a 3-month period. Of those, 39,989 were duplicates, allowing subsequent analysis on the remaining 63,090 unique tweets. Tweets discussing opioid NMUPD formed a distinct cluster, with the silhouette coefficient peak at 0.55 for three clusters. The correlation between our estimate of opioid NMUPD and the most recent federal survey data was outstanding ($R2$=0.89). There was no significant correlation with US population density alone.
Discussion: Until now, social media have played a limited role in public health research, partially owing to a lack of validated methods for estimating essential epidemiological quantities from social media.
Conclusions: Our results demonstrate that a computational linguistic analysis of social media can yield accurately approach validated epidemiological data on prescription drugs.

34. Lead Toxicity from Lead-Contaminated Turmeric

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Background: Lead can be found in high concentrations in spices originating from India and other parts of the world.
Hypothesis: Exposure to contaminated spices should be considered in the evaluation of lead toxicity.
Methods: A 47-year-old male complained of intermittent paresthesias of the hands, face, and body for 4 months. He denied motor deficits, abdominal pain, nausea, vomiting, constipation, or diarrhea. His 38-year-old wife complained of similar but less severe symptoms. Their 11-year-old and 6-year-old children were both asymptomatic. Vital signs and physical exams for the family were non-focal. The family denied use of Ayurvedic, foreign-bought cookware, or makeup. They lived in an over 70-year-old home that had been repainted recently. Due to persistent symptoms in the father, he was treated with two 5-day courses of succimer (30 mg/kg, then 10 mg/kg), which reduced the blood lead concentration over the course of 2 months. No other family members required chelation therapy.
Results: Whole blood lead concentrations are presented in the table. Hemoglobin concentration for the mother was 10.9 g/dL and normocytic. The other family members were within normal limits. Zinc protoporphyrin for the father was 276 mcg/dL and peripheral nerve biopsy taken from him demonstrated autonomic nerve fiber density consistent with small fiber neuropathy. Upon home evaluation by the Department of Health, turmeric the patients brought back from India 6 months prior had a measured lead concentration of 4,000 ppm. The family reported consuming this turmeric daily and that the 6-year-old consumed the least amount.
Discussion: Lead toxicity in a family from chronic daily ingestion of lead-contaminated turmeric required chelation in the most symptomatic family member. Removing the turmeric from the home resulted in adequate decreases in blood lead concentrations. The presence of lead in spices brought to America from South Asia should be considered in the evaluation of lead poisoning. Adulteration of spices with lead may be done to increase weight-based sales, or enhance color and flavor.
Conclusion: Clinicians should consider foreign spices as a source of significant lead exposure.

Table (Abstract 34)

Lead concentrations (micrograms per deciliter) in family members

	Week 0	Week 4	Week 9
47-year-old male	57	27[a]	18[b]
38-year-old female	42	24	16
11-year-old male	27	17	
6-year-old female	9		

[a]After succimer 30 mg/kg for 5 days
[b]After succimer 10 mg/kg for 5 days

35. A Characterization of Occupational Irritant and Asphyxiant Gas Exposures

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Background: Occupational exposures to irritant and asphyxiant hazardous gases are common. Some of these gases are known to results in morbidity and mortality; therefore, characterizing these unintentional exposures may direct efforts for workplace controls.
Research Question: A characterization of occupational irritant and asphyxiant gas exposures.
Methods: Retrospective cohort analysis of unintentional occupational exposures to irritant and asphyxiant gases reported to the National Poison Data System (NPDS) for the period from January 1, 2000 through October 31, 2014.
Results: A total of 20,357 calls for unintentional occupational exposure to irritant and asphyxiant gases were reported to the NPDS during the study period. Carbon monoxide (n=6,457, 31.7 %), chlorine (n=4,338, 21.3 %), and simple asphyxiants (n=2,393, 11.8 %) were the most common exposures. Most exposed employees were 20–29 years old (n=6,236, 30.6 %) and male (n=14,177, 69.6 %). Inhalation or nasal (n=17,994, 82.9 %) and dermal (n=1,640, 7.6 %) routes of exposure occurred most frequently. Reports of headache (n=6,997, 14.5 %), nausea (4,982, 10.3 %), and dizziness/vertigo (n=4,641, 9.6 %) were most common. Of those reporting specific contributing factors, most resulted from poor ventilation (n=747, 36.4 %) or generation of a toxic vapor or fume from mixing products (n=489, 23.8 %). Of the exposures, 11,965 (58.8 %) were evaluated at a healthcare facility while 4,923 (24.2 %) were managed on-site. The majority of exposed cases were treated, evaluated, and released from care (n=11,888, 58.4 %) while others were admitted to a noncritical care unit (n=1,055, 5.2 %) or required critical care (n=656, 3.2 %). Fresh air (n=11,064, 33.1 %) and oxygen administration (n=7, 365, 22.0 %) were the most frequent therapeutic interventions. Health outcomes ranged from no effect (n=1,416, 7.0 %) to death (n=61, 0.3 %), but the majority suffered only a minor effect (n=12,401, 60.9 %).
Discussion: These data demonstrate that employees would benefit from additional workplace controls to prevent hazardous gas inhalational exposures. Proper mixing of chemicals and increased workplace ventilation are areas for training and design improvement. While most exposures resulted in mild effects manageable with minimal intervention, serious health effects can occur, including death.
Conclusion: Given the potential for morbidity and mortality, identifying and mitigating workplace hazardous gas exposures should remain a priority for occupational and environmental medicine professionals.

36. A Comparison of Vasopressor Utility for Drug Overdose-Induced Shock

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Background: Deaths in the US from drug overdose are steadily rising, and increasingly, patients present to emergency departments (EDs) in circulatory shock after a drug overdose. There remains little consensus on the ideal selection of adrenergic agent (vasopressor) in this growing patient population. Although high-dose insulin euglycemia (HIE) for beta-blocker (BB) and calcium-channel-blocker (CCB) overdose has become a first-line treatment based on excellent animal data, there remains little human evidence to support this practice.
Hypothesis: Vasopressor choice and HIE use (when applicable) would impact mortality in drug overdose-related shock.
Methods: This study was a secondary data analysis of a prospective cohort of consecutive ED patients presenting with suspected drug overdose to two urban teaching centers between 2009 and 2014. Inclusion criteria were all adult patients also circulatory shock requiring vasopressors or HIE. Pediatric patients (age <18 years) and caustic ingestions were excluded. Independent variables were the choice of initial vasopressor (both drip and push-dose), as well as a subgroup analysis of BB and CCB overdose and HIE use. Subgroup analysis compared intensive care unit (ICU) length-of-stay and total pressor time in the BB/CCB subgroup.

Results: Fifty-five overdoses were qualified by inclusion/exclusion criteria, and 15 of these included a component of either BB/CCB overdose. For all patients, there approached of mortality benefit when norepinephrine was the initial drip ($p=0.097$). There was significant mortality benefit when phenylephrine was the initial push-dose medication given ($p=0.008$). Risk of mortality was significantly higher when epinephrine was the initial push dose medication given initially ($p<0.05$ 24 h mortality, $p<0.05$ in-hospital mortality). In the BB/CCB subgroup, there was no significant benefit for HIE regarding mortality, ICU length-of-stay, or total vasopressor time.
Discussion: This was not a randomized study, so there could be provider bias in vasopressor choice. For example, sicker patients may have been more likely to receive epinephrine rather than phenylephrine (e.g., cardiac arrest). We were underpowered to demonstrate mortality benefit for HIE and thus do not suggest cessation of HIE for CCB and BB overdose patients.
Conclusion: These data suggest that push-dose phenylephrine is safe, effective, and superior to push-dose epinephrine as the initial medication in undifferentiated drug overdose patients with circulatory shock.

37. A Description of Practice in GI Decontamination with Activated Charcoal at a Large Academic Center

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Background: Activated charcoal (AC), once seen as nearly a universal antidote for poisoning, has had steadily declining use over the past decade, largely due to lack of efficacy, rare but potential toxicity, and low overall poisoning mortality.
Research Question: To analyze current practices involving AC administration at a tertiary-care hospital in an urban center with a bedside Medical Toxicology consult service.
Methods: Retrospective reviews of cases involving AC administration (01/01/2011 and 06/01/2014) were identified. Analysis included comparison in administration using previously published indications and contraindications. Statistical analysis was performed with SAS/STAT.
Results: One hundred of 2,000 overall toxic ingestions (5 %) received AC. Eighty-three percent of these involved intentional self-harm. The median age was 22 years; 59 % were female and 41 % male. The median time to AC administration was 2 h. Eighty-eight percent received single-dose AC, while 12 % received multiple doses. The Medical Toxicology attending authorized 26 %, while 40 % were authorized by poison control, 13 % by EMS, and 7 % by ED attending. Thirty-eight percent of these received AC by nasogastric (NG) tube and 62 %, orally. Twenty-five percent of overall administrations (33 % of cases authorized by a non-toxicologist) did not have acceptable indications (non-toxic, xenobiotic non-binding to AC, presentation delays without potentially severe toxicity, or other acceptable indication) and/or had potential contraindications—43 % had depressed CNS status, 21 % vomiting, and 16 % seizures. One hundred percent of these were authorized by non-toxicology. Thirty-six percent were authorized by EMS, 20 % by residents, 32 % by poison control, 8 % by ED attending, and 2 % by mid-levels. Twenty percent of these received AC via NG tube, while 80 % were received orally. Forty-four percent of these cases had nausea/vomiting, and 8 % had aspiration. Drug Class most commonly treated with AC were antidepressants (17 %), non-opioid analgesics (16), anticonvulsants/mood stabilizers (11 %), and cardiovascular agents (8 %). Twenty-two percent of cases involved major polypharmacy.
Discussion: AC practices differed between our consultant Medical Toxicologist and other medical providers including Poison Center, EMS, Resident Physicians, and ED attending and mid-level providers. Our consultant Medical Toxicologist authorized AC to sicker patients overall, with fewer complications.
Conclusion: AC practices differed between toxicology and non-toxicology authorizors.

38. Changes to Prescribed Psychotropics Following Intentional Overdose

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Background: Psychiatric guidelines regarding suicide risk include prescribing psychotropics with low toxicity. Hospital discharge following medication overdose is a potential opportunity to re-evaluate patients' medications and choose safer medications.
Objective: Determine the influence of hospitalization for intentional drug overdose on prescribed medication regimens.
Methods: This retrospective study was conducted at an urban tertiary care center and approved by the local Institutional Review Board. Patients were identified using TOXIDARE, a pre-existing database of all patients receiving a medical toxicology consult. Consults are called at the discretion of primary medical providers. TOXIDARE patients with at least two visits for overdose were identified. Cases involving accidental ingestion, recreational use, non-medicinal ingestion, or incomplete records were excluded. Admission and discharge medication lists were recorded for each patient and compared for each patient's visit; any medication changes at discharge or a subsequent presentation were identified. Additional data collected included the drugs used in overdose, demographics, and presence of suicidal intent.
Results: Forty-four patients were initially identified, with 18 cases, accounting for 38 encounters, meeting inclusion criteria. Of these, 17 had a single repeat presentation, and one had four presentations. Median age was 38 (range, 18–59 years); 61 % were female. Average time between presentations was 48 days (range of 3–177; median, 36). Twenty-eight encounters (73.68 %) involved a change in prescribed medications. Twenty-seven encounters (71.05 %) noted a change in psychotropic medication prescriptions; 20 (52.63 %) had a psychotropic added; 19 (50 %) had a psychotropic discontinued, and 12 (31.57 %) had psychotropic medications both added and discontinued. Eighteen encounters (47.37 %) recorded no medication changes. Four patients ((22.2 %) subsequently overdosed on the same prescribed medication(s); 5 (27.78 %) used at least partially the same medications, and 8 (44.4 %) used different medications.
Discussion: In this retrospective review, a majority (71 %) of patient encounters for medication overdose involved a change in prescribed psychotropics during the encounter, or at the next presentation. Study limitations include incomplete capture of re-presenting overdose patients and incomplete medical records. In future efforts, we hope to collect greater numbers of patients and characterize whether the specific medication changes involve a change to medications associated with lower toxicity in overdose.

39. Suicidal Adolescents: Examining Self-Poisonings Within the Pediatric Population

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Background: Suicide is a major public health problem in the United States and the third leading cause of death in 10–24-year-olds. Among adolescents, the lifetime prevalence of suicidal ideation and attempt is 12.1 and 4.1 %, respectively. Poisonings are a common method of self-harm encountered in the emergency department.
Objective: Characterize ingestions and outcomes in adolescents with self-harm attempts reported in ToxIC.
Methods: We retrospectively searched ToxIC cases categorized as "Intentional Self-Harm" among 13–18-year-olds. Cases reported as "Unlikely tox related" were excluded. All cases fitting criteria from creation of the database in 2010 through 11/1/2014 were included in analysis.

Results: There were 2,226 cases of toxicologic exposures in ages 13–18 years reported in ToxIC. Seven hundred eighty-three were categorized as "Intentional pharmaceutical overdoses," with 604 subcategorized as "Attempt at self-harm." There were 466 cases of "suicide attempt" (77.2 %), 26 cases of "No suicide intent" (4.3 %); the remaining cases were unknown or unreported. Of patients with suicide attempt, 442 (94.8 %) had signs/symptoms; 344 (73.8 %) were given toxicologic treatment, and 163 (35 %) were admitted to the intensive care unit (ICU). Among patients with no suicide intent, 25 (96.2 %) had signs/symptoms, 16 (61.5 %) required toxicologic treatment, and 7 (26.9 %) were admitted to the ICU; there were no significant differences between groups in these three categories.
Patients presenting with suicide attempt were predominantly female (76.8 % vs 23.2 %, $p<0.05$). A single agent was ingested in 276 (59.2 %) of attempts; 188 (40.3 %) cases involved multiple agents ($p<0.05$) (data missing in two cases). The top three most commonly ingested pharmaceutical classes were analgesics, antidepressants, and anticholinergics/antihistamines, with 201, 161, and 119 exposures, respectively, in the suicide attempt group and 18, 4, and 7 exposures, respectively, in the no suicide intent group.
Discussion: Females presented after attempted suicide more frequently than males, consistent with previous studies. Comparisons between suicide attempt and no suicide intent groups suggests that patients without intent have similar risk for illness severity. The most common classes of agents ingested did not differ between those with suicidal intent and those without.
Conclusion: This study describes characteristics of adolescents with toxicologic exposures. Continued research is needed to prevent pharmaceutical overdose in this population.

40. Characteristics of Patients Undergoing ED and Inpatient Buprenorphine Induction by a Medical Toxicology Service

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Background: The use of buprenorphine within a hospital setting is largely undefined. Recent research suggests an important and effective role for buprenorphine during hospitalization of opioid dependent patients. For treatment of acute opioid withdrawal, few alternatives offer the same safe risk–benefit profile.
Research Question: What are the characteristics of patients undergoing induction with buprenorphine by a medical toxicology service in a hospital setting?
Methods: Medical Toxicology billing and hospital records related to buprenorphine induction were reviewed. Patient demographics, diagnosis, previous chemical dependency treatment (CDT), and outpatient referral and follow-up were reported.
Results: Twenty-three opioid-dependent patients (57 % male, mean age 38 (17–60 years)) received buprenorphine induction from 1/2014 to 11/2014 by our Medical Toxicologist. Thirty-five occurred in the ED; 65 % were done inpatient. Seventeen percent reported prescription opioid use, 52 % heroin, and 30 % both. Fifty-seven percent reported prior CDT. Common diagnoses included opioid withdrawal (35 %), overdose and subsequent withdrawal (17 %), cellulitis (17 %), and abscess (13 %). Infection overall was reported in 39 % (including endocarditis (1), paraspinal abscess (1), leg ulcerations (1)). Most patients were polydrug users (cocaine 57 %, benzodiazepines 30 %). Length-of-stay ranged from ED only (35 %), 2–5 days (30 %), 6–10 days (17 %), 11–20 days (9 %), and 20+ days (9 %). Eighty-three percent of individuals were referred to specific CDT programs at discharge. Five were lost to follow-up. Of the successful 14, 14 % went to a detoxification center, 72 % IOP, and 14 % inpatient. Four individuals were not linked to a program but given counseling/referral packets. One individual was tapered from buprenorphine prior to discharge; one was enrolled in methadone maintenance, and one was started on oral naltrexone after buprenorphine wean in hospital.
Discussion: Buprenorphine use in hospitalized patients is effective for withdrawal management and may improve patient and staff satisfaction. It also is an important therapeutic tool which may facilitate establishment of successful CDT. In our cohort, the majority of patients (65 %) did not come to the hospital-seeking addiction treatment, yet most people were successfully referred with a high rate of follow-up to CDT.
Conclusion: Buprenorphine induction and use in a hospital setting is an effective therapeutic tool. Medical Toxicologists have an opportunity to significantly impact treatment outcomes in opioid-dependent patients.

41. Severe Hyponatremia due to SIADH in an Elderly Patient on a Selective Serotonin Inhibitor and a Thiazide Diuretic

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Background: Sixty one percent of patients' ages 65 years and older are taking at least one prescription medication, and most of these patients are taking between three and five prescription medications. Hypertension is one of the most common diagnoses that older patients have, and thiazide diuretics are among the most common antihypertensive medications prescribed. There have been numerous reports of thiazide diuretics leading to multiple electrolyte abnormalities. Depression is another common diagnosis in the elderly, and selective serotonin inhibitors (SSRIs) are commonly prescribed. A side effect of SSRIs that is not well known is hyponatremia.
Case report: A 93-year-old female with a past medical history of hypertension and hypothyroidism on sertraline, alprazolam, levothyroxine, and losartan–hydrochlorothiazide combination tab presented to the Emergency Department with 1 week of worsening weakness and 1 day of nausea, vomiting, and diarrhea. There were no recent changes in medications and no concern for unintentional overdose. Initial vitals were temperature 97.6 F, heart rate 71, blood pressure 243/99, respiratory rate of 18, and oxygen saturation 95 % on room air. Physical exam was unremarkable except that the patient clinically appeared dehydrated. Initial labs revealed sodium level of 102 mEq/L. Urine osmolality was 372 mOsm/kg, and urine sodium was 59 mEq/L consistent with a diagnosis of syndrome of inappropriate antidiuretic hormone (SIADH). The patient was treated with a combination of normal saline and 3 % hypertonic saline and was discharged 7 days later with sodium level of 136 mEq/L and a normal neurological exam.
Case Discussion: This case described the lowest sodium level in the literature attributed to concomitant thiazide diuretic and SSRI use. Thiazide diuretics cause hyponatremia by inhibiting sodium chloride reabsorption in the distal convoluted tubule, thus impairing urinary diluting capability and lead to a small amount of volume depletion and stimulation of antidiuretic hormone secretion. SSRIs are thought to cause hyponatremia secondary to SIADH.
Conclusion: As polypharmacy becomes more prevalent in elderly patients, it is important for clinicians to know not only the side effects of each medication used in solitarity, but to also to be aware of how use of multiple medications may have synergistic effects.

42. Work-Related Hydrogen Sulfide Exposures Reported to Poison Centers

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Background: Hydrogen sulfide is a toxic gas that is a potent chemical asphyxiant used in industry.

Objective: This study sought to describe work-related cases of hydrogen sulfide exposure reported to poison centers.
Methods: Cases were hydrogen sulfide exposures reported to a state-wide poison center system during 2000–2013 where the exposure reason was "occupational" or the exposure site was "workplace." Exposures to "sewer gas" were excluded. The distribution of cases by selected factors was determined.
Results: In a total of 638 cases, there were 38 multiple-person events involving 102 people (mean, 2.7 persons per event; range, 2–7 persons). The annual number of exposures increased from 31 in 2000 to 88 in 2013. The rate per 1,000,000 population was 89.2 in rural counties and 16.2 % in urban counties. Of 567 patients with a known age, the mean age was 36 years (range, 17–66 years); 91 % of the patients were male. The exposure routes were inhalation (90 %), dermal (9 %), ingestion (7 %), ocular (4 %), parenteral (0.2 %), and unknown (1 %). Eighty-three percent of the patients were already at/en route to a healthcare facility; 9 % were managed on-site. The medical outcome was no effect (10 %), minor effect (30 %), moderate effect (27 %), major effect (7 %), and death (0.3 %). The most common clinical effects were headache (27 %), nausea (25 %), dizziness/vertigo (20 %), vomiting (16 %), dyspnea (15 %), cough/choke (10 %), chest pain (9 %), hypertension (8 %), syncope (8 %), throat irritation (7 %), and drowsiness/lethargy (6 %). The most common treatments were oxygen (52 %), fresh air (36 %), IV fluids (18 %), dilution/irrigation/wash (15 %), and bronchodilators (9 %).
Conclusions: Potentially adverse work-related hydrogen sulfide exposures may involve multiple patients and are more likely to occur in rural areas and involve males. The majority of exposures will occur through inhalation. The number of cases in this study increased over the time period, possibly related to the increasing oil and gas production in the US. The majority of patients were managed at a healthcare facility, possibly because hydrogen sulfide is known to be toxic. However, the majority of exposures were not serious. The most common symptoms affected the neurological, gastrointestinal, respiratory, and cardiovascular systems.

43. Fatal Cobalt Toxicity After Total Hip Arthroplasty Revision for Fractured Ceramic Components

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Background: Metallosis is an uncommon complication of arthroplasty. Systemic cobalt toxicity post-arthroplasty is rare, and to date, we know of only two prior deaths attributed to this complication.
Methods: This is a single patient chart review. The patient is a 60-year-old female with a history of ceramic-on-ceramic right total hip arthroplasty. This was complicated by fractured ceramic components and metallosis of the joint status post synovectomy which required revision to a metal-on-polyethylene articulation. Ten months after the synovectomy, the patient presented to the Emergency Department with right hip pain and worsening dyspnea. She reported progressively worsening hearing loss, metallic dysgeusia, and weight loss since the revision. CTA of the chest revealed bilateral pulmonary emboli. Echocardiogram revealed a new cardiomyopathy with global left ventricle hypokinesis with an ejection fraction of 35–40 % not consistent with heart strain from pulmonary embolism. Serum and 24-h urine cobalt levels were elevated. The plan was to remove the hip prosthesis and chelate with *N*-acetylcysteine and succimer. However, she decompensated with cardiogenic shock. Repeat echocardiogram revealed ejection fraction of 15–20 %. She developed renal and respiratory failure followed by a pulseless electrical arrest and expired.
Results: Serum cobalt level was elevated at 424.3 mcg/L (plasma reference range, 0.1–0.4 mcg/L), and 24-h urine cobalt level was 4,820.5 mcg/L (normal<2.0 mcg/L). Autopsy revealed an extensive metallic effusion surrounding the right hip prosthesis that tested positive for cobalt (41,000 mcg/L). Additionally, cobalt was detected in the myocardial tissue (2.5 mcg/g; normal range, 0.1 to 0.4 mcg/g).
Discussion: This is a case of fatal cobalt-induced cardiomyopathy in a patient whose ceramic components from a total hip prosthesis fractured causing metallosis. This was likely from persistent wear of the new cobalt–chromium femoral head on residual ceramic particles. Providers should be aware of the clinical signs and symptoms related to cobalt toxicity in patients who have prostheses with cobalt–chromium components. In the clinical setting of elevated serum and urine levels, discussions should be made with Toxicology and Orthopedics about possible chelation and removal of the prosthesis.
Conclusion: Patients with cobalt–chromium prostheses are at risk for systemic cobalt toxicity, which can cause fatal cardiomyopathy.

44. A Descriptive Analysis of Naloxone Use in Suspected Opioid Overdoses by Pre-hospital Providers Using EMS Data

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Background: Opioid overdoses are a significant public health problem, now exceeding motor vehicle collisions in annual mortality. This trend has continued, despite the availability of a safe and effective antidote. We describe the magnitude of this problem in a large U.S. city.
Hypothesis: We sought to describe and trend opioid overdoses evaluated by emergency medical services (EMS) providers using an urban EMS database.
Methods: We performed an observational, retrospective study of all suspected opioid overdose patients evaluated by an EMS provider from 2004 to 2013. Opioid overdose events were identified using a search algorithm of pertinent keywords from the EMS narrative iteratively determined to be indicative of an opioid overdose. The study was approved by the institutional review board for the City and the University.
Results: The search algorithm identified 20,555 opioid overdoses from 2004 to 2013. The frequency of opioid overdoses and naloxone administrations appeared to remain stable during this time period, though an increase in administrations is evident in 2006. The frequency of prescription opioid overdoses was found to rise during the study period with an increase of 11 % from 2004 to 2013. Geographically, five zip codes had the highest requency of opioid overdose events. Of the patients receiving naloxone, a positive response was recorded in the narrative observations by paramedics in 42 %, negative or neutral response 13 %, and unclear outcome in 49 % of cases. In the 9 % of opioid overdose patients receiving naloxone with vitals recorded twice by EMS, pulse rate and respiratory rate improved 51 and 76 % of the time, respectively. A random sample subset of 200 patients was further analyzed manually for confirmation and demonstrated that 85.8 % of opioid overdoses involved heroin, 14.2 % involved prescription substances including opioids, and polysubstances were suspected in 15.1 %.
Conclusion: An EMS database can be a resource to follow opioid overdose trends requiring emergency treatment and can inform targeted interventions including identifying high-risk geographic areas for home naloxone distribution and safe use initiatives.

45. Epic Win or Epic Fail? The Effectiveness of Electronic Medical Record Medication Alerts in the Emergency Department

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Background: Integrated electronic medical records (EMR) alerts provide instant feedback when medications are contraindicated, interact with other patient medications, or the dose is incorrect. Designed to be sensitive, there are a large number of alerts that are inconsequential. This can lead to providers indiscriminately ignoring alerts, termed "alert fatigue."

We sought to determine the effectiveness of automated alerts in preventing adverse drug events (ADEs).
Hypothesis: We hypothesize that the majority of EMR alerts are overridden, and ADEs are associated with overridden alerts.
Methods: We performed retrospective chart reviews of the Epic EHR for all patients who were in the ED every fifth day for 4 months, between September 1, 2012 and December, 2013. Charts were abstracted for the number of medication alerts and occurrence of ADEs. Medication orders and alerts were queried through the Crystal data report system in Epic. ADEs were captured by a trained research assistant, through chart review, patient safety network reports, and ICD-9 code queries for ADEs, drug allergies, and drug toxicity. We abstracted if the alert was visible to the provider, the type of provider that saw the alert, their response, patient demographics, and visit variables.
Results: We reviewed 4,831 patient visits which had 20,517 alerts associated with medication orders. See the Table for demographics and visit variables. There were 20,445 visible alerts not associated with an ADE of which 16,470 (80.5 %) were overridden. The proportion of alerts that were visible by provider type (percent overridden) were: pharmacist 38 % (70 %), resident 30 % (84.1 %), attending 18 % (88.7 %), nurse 8 % (89.7 %), physician's assistant 4 % (86.0 %), and 2 % (84.1 %) unclassified. There were 15 visits with an ADE; one patient had four alerts overridden for hydromorphone orders requiring naloxone, and 14 patients had ADEs with no visible alerts (five had unexpected rashes and one hypotension from propofol requiring vasoactive pressors, and nine developed respiratory depression due to opioids.)
Discussion: The vast majority of EMR alerts are overridden in the ED. Pharmacists see the most alerts, but also accept more alerts than other providers.
Conclusion: EMR alerts are largely ignored and pharmacists may play an important role in preventing ADEs.

Table (Abstract 45). Patient demographics and visit variables

	At least 1 drug ordered/ prescribed *n*=4,069 (84.2%)	**No drugs ordered/ prescribed *n*=762 (15.8%)**	**At least 1 visible alert *n*=2,144 (52.7%)**	**No visible alerts *n*=1,925 (47.3%)**
Age, mean (±SD)	41.7 (17.2)	38.9 (13.37)	44.5 (17.6)	38.6 (16.1)
Female gender, n, (%)	2,360 (58 %)	418 (54.9 %)	1,301 (60.7 %)	1,059 (55.0 %)
Pt acuity, mean (±SD)	2.97 (0.77)	3.22 (0.87)	2.8 (0.7)	3.2 (0.8)
ED drug orders, mean (±SD)	4.2 (3.3)	NA	5.4 (3.6)	2.8 (2.1)
Visible alerts, mean (±SD)	5.0 (11.4)	NA	9.5 (14.2)	NA

46. Lithium Intoxication Cases at the Arizona Poison and Drug Information Center (APDIC): Analysis of Hemodialysis (HD) as Treatment

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Background: Lithium (Li) is a mood stabilizer with potential toxic effects above 1.5 mmol/L. Hemodialysis (HD) is one of the treatments utilized to increase lithium clearance with either clinical symptoms or Li level driving implementation of HD.
Hypothesis: Identify APDIC cases of Li toxicity that received HD versus those that did not. Assess if the clinical symptoms or absolute Li level impacted the decision to dialyze. Address limitations of Arizona Poison and Drug Information Center (APDIC) data.
Methods: Descriptive study using Toxicall code 101000, as a single agent exposure, to search APDIC from 2002 to 2014. The 561 patients identified were assessed for Li level and associated symptoms with 348 cases included; 38 were dialyzed, and 310 were not. Categories included acute overdose (AOD n=149; HD, n=17; no HD, n=132), acute on chronic overdose (ACOD n=69; HD, n=8; no HD, n=61) and chronic overdose (COD n=110; HD, n=12; no HD, n=98) based on Li level >4 mmol/L and presence of one or more acute cardiovascular and neurological symptoms.
Results: In the AOD category, 11.8 % cases were dialyzed for Li level alone. In ACOD group, 12.5 % were dialyzed for Li level alone with 12.5 % dialyzed for symptoms alone. In the COD group, of all cases dialyzed, only 33 % met Li level criteria.
Discussion: We assessed the utility of APDIC data in analyzing clinical severity of intoxication determined by Li level and symptomatology impacting the decision to dialyze. In AOD, 88.2 % of cases had clinical symptoms impacting the decision to dialyze. In ACOD, 87.5 % of cases had clinical symptoms affecting the decision to dialyze. In COD, 100 % of cases had clinical symptoms, with 66 % cases not meeting Li level criteria. Despite the lack of symptomatology in several cases in AOD and ACOD, the decision to dialyze was based on Li level criteria alone (11.8 % and 12.5 %, respectively).
Conclusion: Despite recommendations (Hem Int, 2012, 16:3, 407–413), some patients receive HD based on Li level only. This disconnect may be secondary to variability in clinical practice, lack of documentation of contraindications for volume expansion, incomplete APDIC laboratory data, lack of follow up to discharge, or limitations of our database in determining toxicity severity.

47. Use of Cyproheptadine to Treat Serotonin Syndrome from Coingestion of Yohimbine, Methylphenidate, and Dextromethorphan

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Background: Yohimbine is a partial monoamine oxidase inhibitor (MAOI); methylphenidate and dextromethorphan both have serotonergic effects. We report a case of serotonin syndrome resulting from laboratory-confirmed coingestion of these substances, with symptoms resolving after administration of cyproheptadine.
Research Question/Hypothesis: Yohimbine, when ingested with additional serotonergic agents, can cause serotonin syndrome.
Case Report: This is a single patient chart review. A 19-year-old man was brought to the emergency room after having a 15-s tonic–clonic seizure while drinking whiskey with friends. His medical history included attention deficit disorder but no prior seizures or alcohol dependence. Home medications included methylphenidate and over-the-counter supplements (OTC) yohimbine, glucomanin, caffeine, and lecithin. He was

confused and agitated. Vital signs were T 40 °C, HR 116, BP 154/90, and RR 18. He was flushed and diaphoretic, with hyperreflexia and inducible lower extremity clonus. He was sedated, paralyzed, and intubated for increasing agitation.
Results: Head computed tomography, chest X-ray, urinalysis, and laboratory analyses were unremarkable; a urine drug screen was positive for benzodiazepines and opiates. He was given 12 mg of cyproheptadine via orogastric tube for suspected serotonin syndrome with resolution of both clonus and rigidity; his fevers initially persisted (38 °C). Agitation resolved with intravenous sedation (propofol, then dexmedetomidine) and cyproheptatine (2 mg every 1–4 h). He defervesced and was extubated (8 and 12 h after presentation, respectively). Diaphoresis, erythema, lower extremity hyperreflexia, and clonus abated with repeated cyproheptadine dosing. Laboratory values stayed normal except CK (peak, 630 IU/L). He was discharged on hospital day 4 without permanent sequelae. Urine and serum samples analysis (liquid chromatography/time-of-flight mass spectrometry; Shimadzu UPLC, ABSciex 5600 TripleTOF) revealed yohimbine metabolites (10- and 11-hydroxy yohimbine), ritalinic acid (inactive methylphenidate metabolite), midazolam, lorazepam, and acetaminophen. Urine also contained dextromethorphan (and metabolites), acetaminophen, and hydromorphone.
Case Discussion: Yohimbine is thought to have mild serotonergic or MAOI effects; toxicity increases when co-administered with MAOIs. This case illustrates coingestion of methylphenidate and the OTC drugs yohimbine and dextromethorphan, resulting in serotonin syndrome, which improved with administration of cyproheptadine.
Conclusions: Yohimbine and dextromethorphan are widely used OTC medications and may interact with prescription medications to cause serotonin syndrome.

48. A Comparison of Voluntary Reporting Systems and Naloxone Trigger Tool to Identify Adverse Opioid-Related Events

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Background: Opioid analgesics are commonly administered in inpatient settings for the treatment of pain. Providers of all levels of training prescribe these analgesics; multiple formulations, methods of delivery, and potencies can contribute to opioid-related adverse drug effects. Safe opioid administration in hospital is a key quality and safety goal. Several tools to identify opioid-related errors and adverse drug events exist.
Research Question: To compare a voluntary reporting system and naloxone trigger tool for identifying opioid-related medication errors and adverse events in the inpatient setting.
Methods: In a retrospective analysis of cases from a large, tertiary care center, voluntary adverse event reports involving opioid medications were identified. During the same period, we identified cases in which naloxone was administered to adult patients admitted to an intensive care unit or general medical/surgical floor through charge data. Cases in which an a priori opioid-related diagnosis (e.g., heroin overdose) was known were excluded. This study was granted institutional review board exemption.
Results: From 01/01/14 to 03/31/14, there were 261 voluntary reports involving medications; 25 of these involved opioids. The most common error types were omitted drug/dose (32 %), incorrect time (15.6 %), and incorrect dose/drug (15.6 %). Of the cases, all were identified prior to reaching the patient, with NCC-MERP classes A (16 %), B (12 %), C (56 %), and D (4 %). During the same period, the naloxone trigger identified 84 naloxone administrations to unique patients. Of these, five class E (6 %) and two class H (2.4 %) events were recognized.
Discussion: Historically, voluntary reporting systems have been know to capture less than 5 % of the events identified through structured trigger tools. However, the value of voluntary reporting systems may be in capturing a different set of opioid-related medication errors. In this series, the voluntary system identified multiple events that did not reach the patient. In contrast, the trigger tool identified uncommon, yet clinically significant, opioid-related adverse events.
Conclusion: Combined use of voluntary medication error reporting and naloxone trigger-initiated case review may provide a perspective on opioid-related medication errors and adverse events across the potential range of patient harm.

49. Copper Toxicity Associated with Massive Blood Transfusion

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Background: Massive blood transfusions have been associated with a variety of electrolyte and elemental abnormalities; these include hypocalcemia, hypomagnesemia, hypo- and hyperkalemia, and iron overload.
Research question/hypothesis: Massive blood transfusion can result in copper overload.
Methods: This is a single patient case report.
Results: A 23-year-old male with a past medical history of autoimmune lymphproliferative syndrome (ALPS) and associated hemolytic anemia was admitted to the intensive care unit. Two weeks after admission, the toxicology service was called regarding a 24-h urine copper level of 1, 009 mcg (normal, <60). Ceruloplasmin level was 33.7 mg/dL (normal). At the time, the patient had continued refractory cell lysis, requiring transfusion of up to 10 units of packed red blood cells per day. A repeated copper level—ensuring proper collection techniques—was 629 mcg; at that time, plasma copper level was 75 mcg/dL (normal, 70–140 mcg/dL); this decreased over time to 67. A liver biopsy at the time revealed cholestasis, acute hyperbilirubinemia- or medication-induced injury, and significant iron deposition, with a normal copper (12 mcg/g dry weight) and no evidence of Wilson's disease. The patient's elevated copper levels were thought to be due to ongoing blood transfusion; the patient was started on plasma exchange transfusions for treatment of his ALPS. His clinical course was complicated by continued hemolysis, renal failure requiring hemodialysis, and acalculous cholecystitis; his liver biopsy was complicated by massive hemorrhage requiring exploratory laparotomy. He was discharged to home after 2 months in intensive care.
Discussion: One unit of packed red blood cells contains 0.225–0.4 mg of copper; at the peak of his hospitalization, this patient was receiving 1.55–4 mg of copper per day. No exogenous sources of copper could be identified, and studies for Wilson's disease were negative.
Conclusion: In this case, massive blood transfusion appears to have been associated with significantly elevated urine copper levels.

50. Iatrogenic Hepatotoxicity: Dosing Pitfalls of Intravenous Acetaminophen (IV APAP)

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Background: Intravenous acetaminophen (IV APAP) is a relatively new modality for pain control in hospitalized patients. We report a case of hepatotoxicity resulting from IV APAP administration in a malnourished, underweight patient.
Research Question/Hypothesis: Non-adherence to weight and nutrition concerns can result in severe IV APAP-induced toxicity.

Methods: This is a single patient chart review.
Results: A 76-year-old female with a history of hypertension was admitted for treatment of a small bowel obstruction. She denied tobacco and ethanol abuse; her weight was 35 kg (body mass index, 16.6 kg/m^2). Home medications: valsartan, simvastatin, and 81 mg aspirin (all held on admission). Over 48 h of supportive care, she received 1,000 mg of APAP every 6 h, for a total of 8 g. She then underwent surgical lysis of adhesions; thereafter, the patient's transaminases (AST/ALT) increased to 416/316 (from 38/12 on admission). Twelve hours after her last IV APAP dose, AST/ALT increased to 964/744 (APAP, 24.5 mg/dL), and the patient was started on IV *N*-acetylcysteine (NAC). APAP levels had decreased to 4.2 15.5 h later. Over the course of the next 3 days, her AST/ALT peaked at >3,500; total bilirubin increased to 3.4; INR peaked at 2.78 (on NAC). AST/ALT after three courses of NAC—321/1954, bilirubin 2.3, and INR 1.49 (on NAC). Medications administered prior to the onset of transaminitis included: cefoxitin, enoxaparin, filgrastim, furosemide, metronidazole, morphine, pantoprazole, ondansetron, and piperacillin/tazobactam.
Discussion: This patient developed significant hepatotoxicity after receiving 8 g of IV APAP in 48 h. Potential confounding factors include concomitant administration of other hepatotoxic medications; in addition, 5-oxoprolinuria was not ruled out. Given this patient's history and clinical course, however, the amount of APAP administered was likely supratherapeutic, especially given the patient's low body mass index and possibly low glutathione stores.
Conclusions: Although IV APAP is promising as a new modality for inpatient pain control, the risk of hepatotoxicity remains high, especially in patients with traditional risk factors for APAP-induced liver damage. Weight-based dosing for IV APAP should be strongly considered.

51. Chemical Threat Agents Reported in the ToxIC Registry (2010–2013)

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Background: Since 2010, the Toxicology Investigators Consortium (ToxIC) Registry records in a standardized fashion all clinical consults seen by an international multi-center network of medical toxicologists in a standardized fashion. It holds the potential to examine the natural history of chemical threat agent poisoning.
Research Question: Does the Registry contain cases of potential threat agents?
Methods: In recent years, the Department of Defense, the Food and Drug Administration, the Department of Health and Human Services, and the Centers for Disease Control have developed lists of chemicals that are considered potential threat agents. The Registry was queried from 2010 to 2013 for cases entered with an exposure to chemical threat agents identified on these lists. Cases recorded as no or chronic exposure, no signs/symptoms, and signs/symptoms unlikely toxin-related were excluded. This list of agents included: blister agents: Lewisite, nitrogen mustard, phenol, sulfur mustard; blood agents: arsenic/arsine, boron triflouride, brodifacoum, carbon disulfide, carbon monoxide, chlorohydrin, cyanide, diborane, ethylene oxide, fluoroacetate, hydrazines, hydrogen fluoride/ammonium bifluoride/tungsten hexafluoride, hydrogen selenide/selenous acid/selenium, hydrogen sulfide, methemoglobinemia, methylene chloride, potassium chloride, ricin, sodium azide, thallium; choking agents: acrolein, acrylonitrile, ammonia, sodium hypochlorite/calcium hypochlorite/sodium dithionite/sodium borohydride, bromine, chloramine, chlorine, formaldehyde, hydrochloric acid, hydroxides (potassium or sodium), isocyanate, nitric acid, nitrogen dioxide, sulfur trioxide/disulfuric acid/pyrosulfuric acid, phosgene, phosphine, phosphorus trichloride, perfluoroisobutylene, sulfuric acid, sulfur dioxide; nerve agents: botulism, carbamates, nicotine, organophosphates, and tetramine.
Results: Thirty-six institutions from four countries entered 711 cases: 3 blister, 446 blood, 208 choking, and 54 nerve agent. The number of cases and institutions entering a case for each high priority agent are listed in the table. Three deaths were reported: one each with brodifacoum, cyanide, and thallium.
Conclusions: No single site sees enough cases to gather sufficient data on rare and serious agents. The ToxIC Registry provides a resource to compile multiple cases and can serve as a venue for translational research and clinical trials related to chemical threats.

Table (**Abstract 51**)

Agent	No. of cases	No. of sites
Cyanide	35	14
Organophosphate/carbamate	33	16
Brodifacoum	21	13
Nicotine	14	7
Botulism	7	6
Sodium azide	6	2
Thallium	6	3
Ricin	3	3

52. Longitudinal Trends in U.S. Drug Shortages for Medications Used in Emergency Departments (2001–2014)

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Background: In recent years, there has been an increase in U.S. prescription drug shortages. Drug shortages are associated with medication errors and adverse drug events. The impact of shortages on emergency medicine (EM) has not been extensively studied.
Research Question: To describe longitudinal trends in shortages for drugs used within the scope of EM practice.
Methods: Drug shortage data from the University of Utah Drug Information Service were analyzed from January 2001 to March 2014. Two board-certified EM physicians reviewed pharmaceutical shortages and identified products used in EM. They classified shortages as to whether the drug was: (1) used for high-acuity conditions, (2) whether a substitute exists. Standard descriptive statistics and segmented regression analysis examined trends over time.
Results: Of the 1,798 pharmaceutical products with shortages over the study period, 610 drugs (33.9 %) were within the scope of EM practice. Of those, 321 (52.6 %) were used as a direct life-saving intervention or a high acuity condition and of those, 32 drugs (10.0 %) had no available substitute. The medication categories with the most shortage-months were infectious disease drugs (2,374 months) followed by critical care drugs (905 months) (Table). EM drug shortages lasted for an average of 14.7 months (median 9 months). There was a significant upward trend in the number of EM drug shortages from January 2008 to March 2014 ($p<0.001$). During this time period, the number of EM drug shortages per month increased from 28 in 2008, to 83 in 2011, to 120 in the first 3 months of 2014. Similar trends were noted for high-acuity drugs and drugs without a substitute ($p<0.001$).
Discussion: Increasing drug shortages in EM can impact the quality of care for patients. Of particular concern is the potential for errors that occur with the use of unfamiliar therapeutic alternatives, suboptimal treatment, or lack of treatment when indicated.
Conclusions: More than one in three pharmaceutical products impacted by a drug shortage from 2001 to 14 are within the scope of EM practice. Health systems and EM providers must be cognizant of drug shortages

and implement mitigation strategies to avoid adverse impacts on patient care.

Table (Abstract 52). Top Categories of Drugs on shortage used in emergency medicine by shortage months and high-acuity versus non-high-acuity drugs (1/2001–3/2014)

Drug category	Shortage months			
	Number of drugs	Total	High-acuity	Non-high acuity
Infectious disease	62	2,374	1,005	1,369
Critical care	18	905	874	31
Analgesia	18	843	34	809
Gastrointestinal	20	733	126	607
Miscellaneous	20	725	400	325
Toxicology	24	648	646	2
Cardiology	17	631	602	29
Fluids/electrolytes	6	388	371	17
Sedative–hypnotic	8	372	261	111

53. Hyponatremia is Uncommon in Levamisole-Positive Patients

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Background: Large amounts of cocaine in the United States contain the adulterant levamisole, a veterinary antihelmenthic. While cocaine use had not previously been associated with hyponatremia, a recent series of three cases was reported with positive screens for cocaine, positive levamisole, and hyponatremia. Despite the ubiquity of cocaine use and levamisole adulteration, hyponatremia has only been reported in these three cases.
Hypothesis: The incidence of hyponatremia in levamisole-positive patients will be low and similar to the incidence in levamisole-negative patients.
Methods: This is a retrospective chart review. Cases were identified from an existing database of patients with documented laboratory test for levamisole. Charts were reviewed for serum sodium on arrival and at nadir, age, sex, urine drug screen for cocaine, comorbidities, and home medications. The population of patients testing positive for levamisole was compared with those testing negative with descriptive statistics.
Results: Twenty-two patients were identified, with 14 testing negative for levamisole and 8 testing positive. The levamisole-positive population averaged 51 years old (range, 37–63 years), were 50 % male, and all tested positive for cocaine. The levamisole-negative population averaged 44 years old (range, 28–61 years), were 36 % male, and 71 % tested positive for cocaine. Excluding patients negative for cocaine, the serum sodiums on arrival were not significantly different between the groups with levamisole-positive median 137 mEq/L with interquartile range (IQR) 134–137 mEq/L, levamisole-negative median 135 mEq/L with IQR 134 mEq/L-142 mEq/L (p=0.47). The lowest measured serum sodiums were not signficiantly different with levamisole-positive median 135 mEq/L with IQR 129–135 mEq/L, levamisole-negative median 135 mEq/L with IQR 129–140 mEq/L (p=0.82).
Discussion: Hyponatremia was uncommon in levamisole-positive patients. Patients testing both positive and negative for levamisole had similar serum sodium levels, and patients with serum sodium less than 130 mEq/L had other comorbidities to explain the diagnosis. Limitations include a small number of cases for comparison, retrospective chart review, and low incidence of hyponatremia in both populations.
Conclusion: Hyponatremia is uncommon in levamisole-positive patients, with rates similar to levamisole-negative patients.

54. Geographical Relation of RITN Centers to Medical Toxicology Resources

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Background: The Radiation Injury Treatment Network (RITN) consists of 59 centers across the United States that are poised to care for victims of a radiation emergency. The network is organized around bone marrow transplant centers because these facilities have expertise both in radiation medicine and in the care of patients with severe bone marrow depression. A radiation emergency may cause not only irradiation from an external source but also internal contamination with radioactive material. Because medical toxicologists possess training in radiation injury management and expertise in the management of internal contamination, RITN centers may benefit from partnership with medical toxicology (MT) resources, which may be located at an academic medical center, a hospital inpatient clinical service, an outpatient clinic, or a poison center.
Hypothesis: RITN centers have MT resources in their respective cities.
Methods: We examined the geographic location of MT resources with regards to existing RITN centers. Data were derived from public sources.
Results: The majority of RITN centers do not have a MT residency, an inpatient MT service, or an outpatient MT clinic within the same institution. However, 57 % of RITN centers have at least one of these resources located in the same city, and 73 % of RITN centers have at least one of these resources or a poison center within the same city (Table 1).
Discussion: As MT resources can supplement the capabilities of RITN centers in a radiation emergency, medical toxicologists and RITN centers should collaborate during further planning and response efforts.
Conclusion: The majority of RITN centers have at least one MT resource in the same city. Centers that do not can explore other ways to collaborate with these resources like partnering with ones located in neighboring cities or connecting through a national network.

Table 1 (Abstract 54). Type and geographic relationship of MT resources to RITN centers

Resource	n (%) in the same institution	n (%) in the same city
MT residency	8/59 (14 %)	24/59 (41 %)
MT inpatient service	14/59 (24 %)	33/59 (56 %)
MT outpatient clinic	9/59 (15 %)	30/59 (51 %)
Poison center		39/59 (66 %)

55. The Use of Emergency Medicine Oral Boards Simulated Sessions to Evaluate Resident Abilities to Diagnose and Manage Serotonin Syndrome

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Background: There has been little prior research on testing Emergency Medicine physicians-in-training (residents) for their ability to diagnose and treat uncommon diseases like serotonin syndrome (SS). A study in 1999 showed that only 15 % of physicians were even aware of SS as a diagnosis.
Hypothesis: We hypothesize that a majority of residents are unable to diagnose SS but are able to provide clinical treatment in oral boards simulation cases. This study will provide insight into resident recognition

of SS, and this model may provide a novel method for evaluating Resident training.

Methods: We intend to evaluate 76 residents of all training levels in two academic training programs. Subjects are assessed as part of routine practice for emergency medicine oral boards and are blinded to the purpose of the study. Each subject is randomly presented with one of three possible cases of SS by two examiners. Diagnosis and management are assessed by both examiners who are blinded to each other's assessment. Quantitative measurements are made using critical actions predetermined by consensus of local toxicologists via modified Delphi method. Subjects are required to verbalize a final diagnosis for qualitative analysis. Examiner results are compared with determine inter-rater reliability.

Results: To date, 17 residents have been evaluated. Results are shown in the table. Examiner assessments revealed significant deficits in understanding the pathophysiology or consideration of medication interaction as a cause. No subjects performed dangerous actions. Many provided cooling and sedation, but some required prompting to initiate these measure or optimize care.

Conclusion: In 1999, only 15 % of physicians assessed were even aware of SS as a diagnosis. Although these are only preliminary results, we have found 29 % were able to correctly diagnose SS, and 41 % considered this as part of the diagnosis. Senior residents most commonly made the correct diagnosis. Educational efforts should focus on adequate neurologic examinations, effective cooling, and sedative use. The mixed methodology of narrative evaluations and objective statements offer the opportunity to more precisely focus training towards the management of SS. This model may prove useful for assessment of other illnesses.

Table (Abstract 55)

Level of training (*n*)	Serotonin syndrome	Serotonin syndrome+ alternate diagnosis	Incorrect diagnosis
PGY 1 (7)	0	0	7
PGY 2 (4)	1	1	2
PGY 3 (6)	4	1	1

Level of training (N)	Medication history	Neurologic exam	Accurate temperature	Effective cooling	Benzodiazepine use	IV fluids	Toxicology consult
PGY 1 (7)	6	0	7	2	2	7	0
PGY 2 (4)	3	2	4	2	2	4	1
PGY 3 (6)	6	3	6	5	3	5	4

56. Rapid Symptomatic Improvement of Encephalopathy from Valproic Acid Toxicity After Short Course of Intravenous Carnitine

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Background: Valproic acid (VPA) is used as therapy in seizures, mania, and migraines. Toxicity from β-oxidation and carnitine depletion manifests as hyperammonemic encephalopathy and is treated with L-carnitine. Hypothesis: Treatment of VPA toxicity with L-carnitine can produce a rapid improvement in symptoms and ammonia concentrations.

Methods: This is a two-patient chart review. The first patient is a 23-year-old schizophrenic male who was started on 500 mg extended-release VPA daily. Two days later, it was increased to 1,500 mg daily. He presented on day 8 of treatment for lethargy. Vital signs were normal, and physical exam was notable for somnolence and upper extremity tremors. The patient was intubated and treated with L-carnitine with rapid improvement in ammonia concentrations and mental status. He returned to pre-hospital mental status and was discharged with further psychiatric care. The second patient is a 37-year-old bipolar male being treated with extended-release VPA 1,500 mg daily. He presented on day 10 of treatment for stupor. Vital signs were normal, and physical exam was notable for dilated pupils, somnolence, and abnormal movements. L-Carnitine was administered to this patient with a rapid improvement to baseline mental status within 3 h. He was given L-carnitine overnight and evaluated for alternate causes of encephalopathy.

Results: VPA and ammonia concentrations for both patients are presented in the tables. Head computed tomography, metabolic panel, and transaminases were within normal limits for both. Magnetic resonance imaging and electroencephalogram were within normal limits for the second patient.

Discussion: Valproate-induced hyperammonemic encephalopathy is a well-described side effect of this xenobiotic. The estimated time frame for normalization of ammonia concentrations and improvement of CNS function after carnitine administration is unknown. Both of our patients demonstrated a rapid CNS recovery to baseline with concurrent rapid reduction in ammonia concentrations. In fact, our patients showed tenfold and fivefold reductions in ammonia concentrations less than 12 h (patient 1) and 24 h (patient 2) after antidote therapy, respectively.

Conclusion: Use of L-carnitine for treatment of VPA toxicity can result in the rapid improvement of encephalopathy and hyperammonemia.

Table (Abstract 56)

Patient 1 valproic acid and ammonia concentrations

	3 h prior to arrival	ED arrival	12 h	36 h
Valproic acid (μg/mL)		129	86	36
Ammonia (μmol)	434	>700	78	82

Patient 2 valproic acid and ammonia concentrations

	ED arrival	24 h	36 h
Valproic acid (μg/mL)	104	38	18
Ammonia (μmol)	172	35	13

57. Delayed Neurologic Symptoms Occurring More Than 24 Hours After Bupropion Overdose

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Background: Bupropion is a monocyclic aminoketone prescribed for depression and smoking cessation. It inhibits reuptake of norepinephrine, serotonin, and dopamine. The liver produces active metabolites; hydroxybupropion, threo-hydrobupropion, and erythro-hydrobupropion. Features of bupropion toxicity consist of tachycardia, hypertension, seizures, altered mental status, and vomiting. Multiple case reports document delayed neurological effects particularly with sustained-release (SR) and extended-release (ER) preparations, with most occurring within 8 h and typically not beyond 24 h.

Hypothesis: This a case report of symptoms occurring almost 30 h after buproprion SR overdose.

Methods/Case Report: A 53-year-old woman with asthma and acid reflux presented to an emergency department (ED) 8 h after ingesting "a bottle" of bupropion 150 mg SR in a suicide attempt. Physical exam was only significant for a heart rate of 100, and labs were unremarkable. The electrocardiogram (EKG) demonstrated a QTc of 502 ms. She received 1 mg lorazepam and 2 g magnesium, and was admitted to the ICU. After psychiatric clearance, normalization of QTc to 470 ms, and observation for 27 h post-ingestion, the patient was discharged home.

Three hours later, the patient developed trembling, unstable gait, horizontal nystagmus, agitation, and confusion with visual hallucinations. No generalized tonic clonic movements were reported. She returned to the ED 33 h post-ingestion and was given 10 mg haloperidol and 4 mg lorazepam for agitation. Abnormal labs included: lactate 6.9 mmol/L and prolactin 37.5 ng/ml. EKG obtained after medication administration was significant for a QTc of 533 ms. The patient was admitted to the intensive care unit. Repeat EKGs showed QTc of 482 ms. By the morning of day 4, the patient's symptoms resolved. The patient developed rhabdomyolysis with creatinine kinase levels peaking at 13,744 U/L. She was transferred to the floor on day 4, and on day 6, the patient was discharged. Bupropion and hydroxybupropion levels were obtained and are displayed in the table below.
Results: This patient developed delayed neurologic symptoms consisting of visual hallucinations, ataxia, and tremors about 30 h post-ingestion. Interestingly, bupropion levels peaked around 27 h post-ingestion while hydroxybupropion levels peaked around 36 h post-ingestion.
Conclusion: We describe a case where delayed onset of neurologic symptoms occurred 30 h after bupropion SR overdose and corresponded with peaking bupropion concentrations.

58. Frequency of Coagulation Testing in Acetaminophen Overdose without Liver Injury

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Background: In acetaminophen (APAP)-induced liver injury, the international normalized ratio (INR) is an important prognostic indicator. However, APAP itself and *N*-acetylcysteine (NAC) treatment can both increase the INR in the absence of liver injury.
Research Question: What proportion of acute APAP overdose patients with normal or near-normal aminotransferases (AT) reported to a regional poison center (RPC) have coagulation testing, and how often do results influence treatment?
Methods: This is a retrospective review of acute exposure cases evaluated at a health care facility (HCF) and reported to a RPC between 1/1/11 and 12/31/13 with detectable serum APAP, initial AT <100 U/L, and age >12 years. Patients on warfarin were excluded. Cases were reviewed for coingestants, NAC treatment, and lab values reported by the HCF. If AT increased to >100 during hospitalization, coagulation testing was considered appropriate. The RPC only recommended coagulation testing of APAP overdose patients in the setting of liver injury.
Results: Seven hundred twenty RPC charts met entry criteria. HCFs reported coagulation testing was done in 92 cases (12.8 %). In 11/92, results were reported to the RPC as "normal" without quantitative values. In three cases only a prothrombin time (PT) or partial thromboplastin time was provided. Specific INR values were available in 78 cases (range, 0.8–1.6), of whom 70 (89.7 %) received NAC. In 75 of these cases (96.2 %), INR was <1.5. In seven cases, AT rose following admission, and this may have prompted INR testing. No undeclared anticoagulant coingestants were discovered. No changes in management based on coagulation results were documented other than repeat PT/INR determination.
Discussion: The 12.8 % of patients followed by a single RPC for acute APAP overdose with initial AT <100 U/L had coagulation testing performed, though 7.6 % of these had rising AT that may have prompted the tests. Results do not appear to have changed patient management. In some cases, the test may have been performed but not reported to the RPC because specialists only requested coagulation results when AT were elevated.
Conclusions: Guidelines recommending PT/INR determination only for specific indications such as documented liver injury might help to further reduce unnecessary testing.

59. Start Me Up! Recurrent Defibrillations in Refractory Ventricular Tachydysrhythmias Following Intentional Caffeine Powder and Pill Ingestion

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Background: Near-pure powdered caffeine is sold as a dietary supplement, with instructions to ingest 1/64th to 1/16th of one teaspoon (approximately 50–200 mg). Several recent deaths highlight the danger associated with increased access to concentrated caffeine. We report a case of refractory cardiac arrest, treated with multiple defibrillations and hemodialysis, to highlight the risk of powdered caffeine.
Hypothesis: Ingestion of concentrated powdered caffeine risks inadvertent overdose and the development of severe toxicity.
Methods: A 20-year-old woman presented emergently with severe agitation, tremor, and vomiting, approximately 1–2 h after consuming caffeine (powder and tablets) in a suicide attempt. Within minutes of arrival, ventricular fibrillation occurred. After defibrillation, intubation, and amiodarone (300 mg IV, followed by infusion), return of spontaneous circulation (ROSC) was achieved. Activated charcoal was administered via nasogastric tube. Three minutes later, she developed pulseless ventricular tachycardia (VTach), with ROSC after defibrillation and lidocaine (100 mg IV, followed by infusion). Over the next 50 min, she experienced 23 pulseless VTach episodes, each responsive to defibrillation. An esmolol infusion was started, and pulseless VTach frequency diminished.
Results: Hemodialysis was initiated once hemodynamic stable. Extubation occurred the following day. Beta blockade was continued with oral metoprolol. She was transferred to inpatient psychiatry on day 7, with full neurological recovery. Serum caffeine concentrations, performed approximately 6 and 18 h post-ingestion (pre- and post-dialysis), were 240.8 and 150.7 mcg/mL, respectively (following a single oral 300 mg caffeine dose, 1-h peak plasma concentrations range from 6.0 to 9.0 mcg/mL).
Discussion: Caffeine, one of the most widely consumed xenobiotics, is easily available through unregulated commercial and Internet venues in a concentrated powder form. In July 2014, a Food and Drug Administration (FDA) warning about direct consumer marketing of pure powdered caffeine advised avoidance of these products and highlighted the risk of inadvertent overdose due to difficulties in accurate measurement of an appropriate dose. Despite the FDA warning, powdered caffeine remains available.
Conclusion: Pure caffeine powder is associated with consequential cardiac toxicity. Given its easy availability and high toxicity, enhanced regulatory oversight may be required.

60. Retrospective Observational Case–Control Study Comparing the Effectiveness of Activated Charcoal and Resin Hemoperfusion on Treatment of Acute Paraquat Poisoning

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Background: Acute paraquat poisoning is common in Vietnam. The aim of this study was to compare the effectiveness of activated charcoal hemoperfusion (ACH) and resin hemoperfusion (RH) on clinical outcomes of acute paraquat poisoning treatment.
Methods: (1) This was a retrospective observational case–control study. Sixty-two patients with acute paraquat poisoning were enrolled. Thirty-four patients were treated with ACH and 28 with RH. Both groups received similar pulse therapy of methylprednisolone, cyclophophamide, and other detoxification methods including gastric lavage, activated charcoal, and supportive treatment. Mortality was determined after 2 months of hospital discharge. (2) Study facilities: RH group at Fresenius Medical Care 4008S machine with HA230 resin hemoperfusion cartridge

and rexeed L13 filter and enoxaparin was used as anticoagulant; ACH group: Activated charcoal filter suitable with Prismaflex machine using heparin as anticoagulant was performed. Urine paraquat concentration (UPC) was measured by optic method.
Results: (1) Two groups were matched for age, male/female ratio, time from ingestion to local hospital, time from ingestion to first hemoperfusion, UPC, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin, and PaO_2. (2) 1.3±0.68 [1–4] times of hemoperfusion was applied for ACH group fewer than for RH with 2.5±1.29 [1–5] (p=0.01). Following the first course of hemoperfusion, the rate of decrease of UPC has decreased to 79.9±21.59 [49–100] in ACH and 87.1±17.26 [50–100] (%) in RH (p=0.294); there were no differences in UPC, AST, ALT, total bilirubin, and PaO_2 between two groups except for creatinine (81.0±34.17 [35–165] in RH vs. 111.4±59.91 [37–237] μmol/L in ACH, p=0.029); rate of decrease of platelets has decreased significantly 53.6±14.37 [13–78] in ACH versus 31.9±20.53 [3–66] (%) in RH (p=0.0001). (3) The mortality were 25/31 (80.6 %) in ACH versus 12/25 (48 %) in RH (p=0.011). Six missing patients distributed to two groups were not determined if alive or not.
Conclusion: One course of treatment with ACH and RH decrease the UPC to a similar extent, but more time of RH was associated with decrease in mortality of acute paraquat poisoining; RH clearly had lower fall in platelets count than ACH.

61. Antidotal Therapy by Intravenous Lipid Emulsion: Observations from the Toxicology Investigators Consortium (ToxIC)

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Background: Intravenous lipid emulsion (ILE) therapy is being increasingly used in the management of lipophilic drug overdoses. However, the safety and effectiveness of ILE therapy have not been systematically studied and are presently limited to isolated case reports and small series. To address this knowledge gap, in May 2012, the Toxicology Investigators Consortium (ToxIC) of the American College of Medical Toxicology launched a prospective sub-registry, dedicated to overdose cases managed by ILE.
Objectives: The primary objective of this study is to describe the overdoses and clinical context in which ILE therapy is being employed by medical toxicologists.
Methods: This is a prospective cohort study of all individuals treated with ILE therapy at the 47-site case registry of the Toxicology Investigators Consortium (ToxIC) between May 2012 and October 2014.
Results: A total of 51 patients were managed by ILE therapy, originating from 19 medical centers within ToxIC. The median age was 47 (IQR 32–56) years; 31 (60.1 %) were female. The most common reasons for ILE administration were calcium channel blockers (n=19; 8 were verapamil), beta blockers (n=12, 2 were propranolol), injected local anesthetics (n=4), bupropion (n=3), quetiapine (n=3), lamotrigine (n=3), and tricyclic antidepressants (n=3). The most common clinical indications for ILE administration were refractory hypotension (SBP<90 mmHg; n=34), central nervous system depression (n=32), bradycardia (HR<50; n=22), metabolic acidosis (pH<7.2; n=18), ventricular dysrhythmias (n=13), and seizures (n=10). Prior to administration of ILE, the most commonly administered treatments were vasopressors (n=28), hyperinsulinemic-euglycemia therapy (n=23), sodium bicarbonate (n=19), calcium (n=18), and atropine (n=9). A question regarding complications during ILE therapy was answered in 13 cases (25.5 %), six of whom described complications (interference with interpretation of laboratory data; n=5) and pancreatitis (n=1).
Conclusion: ILE therapy by medical toxicologists in the United States is primarily reserved for critically ill patients with lipophilic drug exposures, often as a last option, after other life-saving treatments, such as vasopressors and hyperinsulinemic euglycemia, have failed.
*The Management with Intravenous Lipid in Overdose (MILO) Study Group: Michael Beuhler, Jeffrey Brent, Rebecca Bruccoleri, Bradley Demeter, Diane Felton, Yaron Finkelstein, Stephanie Hernandez, Jerrold Leikin, Michael Levine, Phillip Moore Phillip, Sean Rhyee, Bradley Riley, Adam Rowden, Michelle Ruha, Daniel Rusyniak, Eric Smith, Craig Smollin, Sam Stellpflug, David Vearrier, Rais Vhora, Paul Wax, Tim Wiegand

62. Estimating the Impact of Adopting the Revised United Kingdom Acetaminophen Treatment Nomogram in the US Population

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Background: The decision to treat an acute acetaminophen overdose patient is based on plotting the acetaminophen concentration on the Rumack-Matthew nomogram. In 2012, the UK's Medicines and Healthcare Products Regulatory Agency lowered the treatment threshold by 50 %, mandating treatment if a 4-h acetaminophen concentration exceeded 100 mcg/mL.
Hypothesis: We hypothesize the number of additional patients who would require treatment for acetaminophen ingestions can be estimated using data from a diverse group of hospital Emergency Departments (EDs).
Methods: In this institutional review board-approved study, patients >13 years who presented to one of seven US hospitals with an acute acetaminophen ingestion between 7/1/2008 and 6/30/2013 were screened. Patients who would require treatment based on the current (revised) UK nomogram, but not the current US nomogram, were included. The estimated number of cases nationally was extrapolated by taking the proportions of cases at each hospital as a percentage of total ED visits for that center and applying this to the total number of annual ED visits in that participating county and then to the US. County and national visit information was obtained from the Area Health Resources Files from the Department of Health and Human Services.
Results: One hundred seven eligible patients were identified. The median age was 23 (18–35) years; 63 % were female. Applying the revised UK nomogram to the US population would result in treating an additional 5.4 cases/100,000 patients. Extrapolating this number nationally, an estimated 6,951 (95 % CI 0–24,585) additional patients would be treated annually.
Discussion: Patients whose acetaminophen concentration falls below the currently used US nomogram historically have a very low rate of developing hepatic failure. Adapting the current UK treatment strategy in the US would increase the number of patients treated (and exposed to potential iatrogenic complications) and increase costs without providing any likely clinical benefit.
Conclusion: Adopting the revised UK treatment threshold to acute APAP ingestions in the US would result in treating an additional 6,951 patients annually.

63. Clinical Characteristics and Treatment Practices in Patients with Acute Insulin Overdose

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Background: Hypoglycemia following a therapeutic dose of insulin is common. There is a paucity of data on insulin overdoses, however.
Hypothesis: The primary objective is to describe the clinical features and treatment practices of patients with insulin overdoses.
Methods: The records of all patients (age >14 years) treated on a toxicology service for an insulin overdose who presented between 1/1/2002 and 10/1/2013 were reviewed. Subjects who developed hypoglycemia but without a history of overdose were excluded. The following definitions were created a priori: hypoglycemia (glucose<60 mg/dL) and concentrated dextrose infusion (infusion containing a minimum of 10 % dextrose). For subjects with multiple admissions for insulin overdose, only the first visit was included.
Results: Twenty-seven unique patient encounters who met entry criteria were identified. Twelve were male; the median (interquartile range (IQR)) age was 35 (27–47) years. The median (IQR) amount of insulin injected was 260 (110.5–600) units. The following types of insulin were implicated: exclusively short-acting (n=5); exclusively long-acting (n=6), combination of short- and long-acting (n=12); unknown (n=4). All subjects had normal renal function on admission. The median (IQR) initial and nadir glucose was 64 (33–133.5) and 39.5 (22–48) mg/dL, respectively. Five subjects were treated with only 5 % dextrose solutions. The remainder received concentrated dextrose solutions [10 % (n=17); 12.5 % (n=1); 20 % (n=2); 25 % (n=1); 50 % (n=1)]. Concentrated dextrose was infused for a median (IQR) of 20.5 (12–28.9 h) (range, 1–72 h). The median (IQR) amount of dextrose administered was 410 (146.25–547.5 g) (excludes maintenance (5 %) dextrose infusions). The 26/27 (96 %) were discharged without sequelae; one patient presented with an anoxic brain injury and was discharged to hospice.
Discussion: In this case series on insulin overdose, most subjects required large doses of exogenous dextrose. While hypoglycemia was consistent with the expected duration of actions in some subjects, many subjects required concentrated dextrose solutions beyond what would be the expected duration of action of insulin.
Conclusion: Subjects with insulin overdose frequently require large doses of exogenous dextrose. The use of concentrated dextrose solutions is common.

64. A Prospective Observation Study of Medical Toxicology Consultation in a US Combat Theater

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Background: Since 2001, US military personnel and physicians providing medical support have been deployed to Afghanistan. Those medical providers tasked with caring for military personnel in Afghanistan must face the challenge of diagnosing and treating various toxicological exposures. Military physicians must also function with limited resources. Study of toxicological exposures that occur during deployment may aid in guiding physician predeployment training, appropriate allocation of medical resources to the area of operation, and improve the quality of patient care provided in a deployed location. Furthermore, management of patients in an Emergency Department observation unit may limit the costs of admitting and transporting patients out of theater.
Hypothesis or Research Question: To describe the types, frequency, and treatment of toxicology patients during 5 months at a military combat hospital in Afghanistan.
Methods: Prospective observational study in a military combat hospital.
Results: Fourteen patients were treated in theater, 11 directly by a military medical toxicologist, and three by in theater teleconsultation (Table). The three teleconsultation patients were Afghan civilians who consumed methanol during clandestine ethanol production. The remainder of patients were US citizens or military personnel. Five cases were attempts at recreational euphoria; two were self-harm attempts; two were from performance enhancing supplements, and one was an accidental occupational exposure. Three of the patients were admitted to the intensive care unit with toxicology consultation and evacuated out of theater. The remaining eight patients were managed by a toxicologist in the Emergency Department observation unit. The opioid ingestions required serial boluses of naloxone and the dextromethorphan, dextroamphetamine, and alcohol withdrawal patients were treated with benzodiazepines or ketamine.
Discussion: Similar to the findings in our previous deployment teleconsultation study, toxicology consultations for US soldiers consist mostly of abuse of non-prescription medications and performance enhancing supplements. This may be due to the frequent urine drug screen testing of US military personnel for illicit drug use dissuading military personnel from abusing illicit xenobiotics.
Conclusion: This is the first study to describe bedside toxicology consults for US combat forces and in particular use of an observation unit for critically ill patients.

Table (Abstract 64). Categories of xenobiotics treated in the combat theater by medical toxicology

Type of exposure	Number	Percentage
Methanol	3	21 %
Dextromethorphan	2	14 %
Supplements	2	14 %
Opioids	2	14 %
APAP/doxylamine	1	7 %
Dextroamphetamine	1	7 %
Pine oil	1	7 %
Alcohol withdrawal	1	7 %
Chlorine	1	7 %

65. Myopathy Following Acute Cutaneous Chlorophenoxy Herbicide Exposure

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Background: Chlorophenoxy herbicides have well described toxicity when ingested. Five cases of systemic toxicity secondary to cutaneous exposure were documented between 1959 and 1963.
Hypothesis: Prolonged cutaneous exposure to 2,4-D can cause acute peripheral neuropathy and myositis.
Methods: This is a single patient chart review. A 46-year-old male farmer presented to his primary care physician with extremity weakness. The patient reported an equipment malfunction which soaked the patient's skin and clothes, which he continued to wear for several hours, in an unknown concentration of the pesticide 2,4-D 1 week prior to presentation. The patient described a 2-day history of extremity pain and progressive motor weakness in his arms and legs resulting in difficulty ambulating. Physical exam revealed diffuse motor weakness with decreased deep tendon reflexes.
Results: The patient was sent to the emergency department where he was found to have a creatinine kinase (CK) of 1,090 IU/L with normal renal function. The patient was admitted and treated with intravenous hydration and sodium bicarbonate. His CK peaked at 2,000 IU/L on hospital day 1. The following day, the patient's CK decreased to less than 700 IU/L, and his weakness improved. The patient made a full recovery over the next week.
Discussion: While significant chlorophenoxy herbicide toxicity typically occurs following ingestion, based upon previous case-reports and case-series, prolonged cutaneous exposure can cause a delayed, progressive

mixed sensory–motor peripheral neuropathy with mild elevations of creatinine kinase. However, over the last 30 years, there have been no published reports of acute chlorophenoxy herbicide poisoning following dermal exposure. This case follows these previously described cases in that the patient was exposed to 2,4-D for a prolonged duration (pesticide soaked clothes); he developed extremity weakness and paresthesias 4 days later; a mild elevation in his creatinine kinase occured, and his symptoms slowly resolved over the next week. The patient denied exposure to other toxic agents, symptoms of illnesses associated with Giuillan-Barre, or utilization of statins or other medications associated with motor weakness.
Conclusions: Patients with prolonged cutaneous exposure to 2,4-D may be at risk for developing reversible acute peripheral neuropathy and myositis.

66. How Frequently Are Drug Interactions Identified In Patients on Warfarin Presenting to the Emergency Department With a Supratherapeutic INR?

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Background: One of the most serious complications from warfarin therapy is bleeding, the risk of which increases with an increasing International Normalized Ratio (INR). Frequently, a drug interaction involving warfarin is the cause of this elevated INR.
Study Question: We hypothesize that drug interactions will be identified as a cause in a majority of patients on warfarin presenting to the emergency department (ED) with a supratherapeutic INR (S-INR).
Methods: The study was approved by our institutional review board. The study was designed as a prospective observational study over an 18-month period. The author and a dedicated research nurse identified patients on warfarin with a supratherapeutic INR who presented to the ED. A questionnaire was completed that included a comprehensive review of all the patients medications, including new meds, recently prescribed and completed prescriptions, over the counter meds, and dietary or herbal supplements. Exclusion criteria included critical illness, unwillingness to participate, or inability to complete the questionnaire.
Results: Forty-seven patients were identified in the study period. Mean S-INR was 5.9 (range, 4.1->10). Serious bleeding complications (intracranial hemorrhage, gastrointestinal bleeding, uncontrolled epistaxis) were present in 4/47. Of these 47, a clearly identifiable trigger for the S-INR was identified in only 20. Of these, a prescription for ciprofloxacin was the most common etiology (7/20), followed by prescriptions for other antimicrobials (5), NSAID (5), and increased dose of warfarin (3). No dietary of herbal supplement use was identified that was felt to be contributory.
Discussion: A clear trigger for S-INR was identified in less than half the patients in this study. Limitations include potential recall bias by the patients and inability to control for accuracy of reported dosing (many patients were on alternating dosage schedules of warfarin and may have doubled up on doses inadevertently). Ciprofloxacin was the most common drug implicated.
Conclusion: An etiology for S-INR in patients taking warfarin was found in less than half the patients in our study. Of the etiologies identified, all were prescription drug-related, reflecting the need for provider education and better system redundancies to improve medication safety.

67. Clinical Toxicity of Synthetic-Cannabinoid Receptor Agonist Overdose

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Background: Synthetic cannabinoid receptor agonists (SCRAs) are heterogeneous compounds developed as probes of the endogenous cannabinoid system or potential therapeutic agents, which clandestine laboratories subsequently synthesize and market as abusable designer drugs. We assessed clinical toxicity associated with recent SCRA use in a large cohort of drug overdose patients.
Hypothesis: Based on prior literature, we hypothesized significant associations with agitation and cardiotoxicity when compared with marijuana.
Methods: This subgroup analysis of a large drug overdose cohort study involved consecutive ED patients at two large urban teaching hospitals collected between 2009 and 2013. Clinical characteristics of patients with exposure to SCRAs (SRCA subgroup) were compared with patients who smoked regular marijuana (MJ subgroup). Data included demographics, exposure details, vital signs, mental status, and basic chemistries gathered as part of routine clinical care. Study outcomes included altered mental status (agitation, Glasgow Coma Scale), and cardiotoxicity (myocardial injury, dysrhythmia). Dysrhythmia was defined as ventricular tachycardia or fibrillation. Assuming 30 % prevalence of the predictor and outcome, we calculated the need to enroll 84 patients to show 3.5-fold relative risk with 80 % power and 5 % alpha.
Results: Eighty-nine patients reported exposure to any cannabinoid, of whom 17 reported SCRAs (17 cases, 72 controls, mean age 38.7, 78 % males, 34 % Hispanic). There were no significant differences between SRCA and MJ with respect to demographics (age, gender, race/ethnicity), exposure history (suicidality, misuse, intent), or vital signs. Laboratory variables associated with SCRA overdose were lower mean bicarbonate ($p<0.05$) and elevated serum glucose ($p<0.05$). Mental status varied between SRCA and MJ, with agitation significantly more likely in SCRA subgroup (odds ratio (OR), 3.3; confidence interval (CI), 1.1–9.6). Cardiotoxicity was more pronounced in the SCRA subgroup with dysrhythmia significantly more likely (OR, 9.8; CI, 1.0–116).
Discussion: SRCA overdose was found to be more clinically significant compared with MJ toxicity. Therefore, future studies should assess optimal treatment modalities to prevent adverse clinical outcomes following SCRA overdoses.
Conclusions: SCRA overdose was significantly associated with more severe clinical toxicity than MJ, including metabolic abnormalities, neurotoxicity, and cardiotoxicity.

68. Gastric Lavage: Ten Years' Experience at One Poison Center

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Background: Gastric lavage fell largely out of favor after publication of position statements starting in 1997, most of which limited recommendations for lavage to very specific circumstances. Despite this, some providers still perform gastric lavage, though they often lack the expertise and equipment to do so effectively.
Research Question: Are providers in our service area selecting appropriate patients and techniques for gastric lavage?
Methods: A retrospective chart review was performed for all healthcare facility managed calls to the Virginia Poison Center (VPC) from November 1, 2004 through November 1, 2014. Cases from this period that had gastric lavage coded as performed were reviewed. Clinical data abstracted to a data collection spreadsheet included: equipment used for the lavage, any reported result of the lavage, adverse effects of lavage, and the final outcome coded.

Results: Out of 71,451 cases managed in healthcare facilities during the study period, 203 cases were included in the study. The VPC recommended lavage in seven of these. There were 19 adverse events related to lavage. Frequency of lavage fell off sharply over time, from 43 cases the first 12 months to two cases the last 12 months. Equipment description was available in 108 cases; nasogastric tubes were used in 101 of these. Lavage results were described in 127 cases, of which pill fragments or similar materials were described in 97. Case outcomes were more severe in the lavage group than in the total population of patients managed in a healthcare facility during the same period (Chi-square (5)=136.9, $P<0.0001$).
Discussion: These results demonstrate that gastric lavage is a rare event and becoming more so. Despite predominate use of smaller gastric tubes, return of pill fragments or similar materials was still frequently reported. Whether the more severe outcomes seen with lavage are due to selection bias or effects of the lavage is unclear. This study is limited by its retrospective design and reliance on poison center charts, with resultant significant gaps in the available data.
Conclusion: Gastric lavage is often performed despite PCC recommendations, typically with inappropriate equipment, and is associated with more severe final outcomes.

69. Trends in Outpatient Benzodiazepine Prescribing, 2005–2010

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Background: Emergency department (ED) visits for benzodiazepine (BZD) overdose, particularly alprazolam, have approximately doubled between 2005 and 2010. How outpatient BDZ prescribing trends reflect overdose trends is less well described.
Research Question: To characterize trends in BZD prescribing in US outpatient offices and clinics as well as EDs, with a focus on utilization of specific agents.
Methods: A retrospective review of data from the CDC's National Hospital Ambulatory Medical Care Survey and National Ambulatory Medical Care Survey 2005–2010 was performed. All adult (age ≥18 years) ED and outpatient office and clinic visits during which a BZD was prescribed were included. Trends in outpatient prescribing of individual BZDs were evaluated. The proportion of visits during which a BZD was prescribed was tabulated, and trends were analyzed using survey-weighted logistic regression.
Results: Out of an estimated 741 million ED visits between 2005 and 2010, 5.6 million (0.7 %) visits included a BZD prescription at discharge. Between 2005 and 2010, there were an estimated 4.8 billion ambulatory care visits, of which an estimated 235.4 million (4 %) visits included a BZD prescription. Overall, ED BZD prescribing did not change over time (0.9 vs. 1.0 % of visits, $p=0.112$); however, BDZ prescribing in the ambulatory care setting increased 25.6 % (4.3 to 5.4 % of visits, $p=0.003$). The most commonly prescribed BZD from the ED was lorazepam whereas alprazolam was the most common from outpatient offices and clinics. Alprazolam prescribing did not significantly increase during the study period from the ED or in the ambulatory care setting (Table).
Discussion: Additional factors, such as increased misuse or diversion of prescribed medications as well as obtainment from other sources such as online pharmacies, may contribute to rising BZD overdose rates.
Conclusion: Outpatient prescribing of BZDs did not increase to the same extent as BZD-related ED visits, particularly with regard to alprazolam prescriptions. Providers must be cognizant of the potential for misuse, abuse, and diversion when prescribing these medications.

Table (Abstract 69). Trends in individual BZD prescribing over time

Medication	2005 (%, no. visits)	2010 (%no. visits)	% Change	*P* value
Alprazolam: ED	0.3 %, 257,928	0.2 %, 242,299	−33.3 %	0.624
Ambulatory care	1.9 %, 14,704,987	2.1 %, 17,152,681	10.5 %	0.395
Clonazepam: ED	0.1 %, 69,775	0.1 %, 110,016	0.00 %	0.038
Ambulatory care	0.9 %, 6,686,201	1.3 %, 10,689,036	44.4 %	0.001
Diazepam: ED	0.2 %, 206,949	0.3 %, 333,972	50.0 %	0.048
Ambulatory care	0.6 %, 4,690,359	0.7 %, 5,685,723	16.7 %	0.237
Lorazepam: ED	0.3 %, 231,228	0.3 %, 275,232	0.00 %	0.259
Ambulatory care	1.1 %, 8,437,783	1.3 %, 10,864,236	18.2 %	0.129

70. Drug Shortages: Implications for Medical Toxicology

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Background: Prescription drug shortages have become increasingly prevalent over the past decade. There are limited data as to how drug shortages can impact medical toxicology.
Research Question: To describe drug shortages affecting the management of poisoned patients.
Methods: Drug shortage data from January 2001 to December 2013 were obtained from the University of Utah Drug Information Service. Two medical toxicologists reviewed pharmaceutical products affected by shortages and identified agents that are used in medical toxicology. Shortage data were analyzed focusing on the type of drug involved, formulation, reason for shortage, shortage duration, marketing status (brand vs. generic), and if the drug was a single-source product (produced by one manufacturer). The availability of a substitute therapy and whether the alternative was also affected by a shortage at any time during the study period was also noted.
Results: Of 1,751 products in shortage during the study period, 141 (8.1 %) were used in medical toxicology. The number of shortages reported annually increased steadily from the mid-2000s, reaching a high of 26 in 2011, with a slight decline in recent years. Of 141 shortages, 21 (14.9 %) were unresolved as of December 2013. The median duration of resolved shortages was 166 days (interquartile, 85–469). Generic drugs were involved in 85.1 % of shortages and 41.1 % were single-source products. Parenteral drugs were more commonly affected by shortages (126, 89.4 %). The most common type of medication involved were sedative–hypnotics (benzodiazepines/barbiturates). An alternative agent was available for 121 (85.9 %) drugs; however, 88 (72.7 %) of these alternatives were affected by a shortage. The reason for shortage was not reported for 50.4 % of drugs. When present, the most common reason reported was manufacturing delays (20.6 %), followed by supply/demand issues (17.0 %).

Discussion: Drug shortages are becoming increasingly prevalent in medical toxicology, which can have quality and safety implications for patient care. Shortages for single-source products are a major concern if a suitable alternative is unavailable for a poisoned patient.
Conclusion: Drug shortages affected a substantial number of agents used in the management of poisoned patients. Medical toxicologists must be aware of current shortages and implement mitigation strategies to optimize patient care.
Table (Abstract 70). Medical toxicology agents without alternatives frequently in short supply

Agent	Number of times in shortage	Days in Shortage
Antivenin *Latrodectus mactans*	3	362, ongoing since 12/2010
Digoxin rescue agents	2	262
Lipid emulsion	1	Ongoing since 11/2008
Methylene blue	3	898 ongoing since 3/2013
Naloxone	6	1,601
Pralidoxime	2	987
Protamine	4	1,228

71. Use of Home Air Fresheners Is Associated with High Body Mass Index in an Emergency Department Population

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Background: Over the past 20 years, the incidence of obesity and associated diseases has risen strikingly, becoming a global health crisis. While decreased physical activity coupled with increased caloric intake is frequently cited as the root cause of this dramatic rise, there have been recent studies that suggest that environmental obesogens, and more specifically, endocrine disrupting chemicals (EDCs) may play a role. We hypothesized Body Mass Index (BMI) of Emergency Department patients may correlate with frequent exposure to specific environmental obesogens.
Methods: A convenience sample of subjects was enrolled from patients presenting to an Emergency Department. Each participant was asked to complete a detailed written survey regarding their lifestyle including exercise, dietary habits, consumption of fast foods and caloric beverages, exposure to environmental chemicals, and use of personal care products. Average BMIs of those subjects with exposure to defined chemicals were compared with those without the exposures using paired *t*-test ($p<0.05$= significance.
Results: A total of 104 subjects completed the survey. The average BMI of respondents was 34.30±10.49 (median, 32.3). Female subjects had significantly higher BMIs than males (36.43 vs. 31.00, $p<0.05$). There was no correlation between BMI and reported lifestyle choices, diet, exercise, and chemical exposures with one exception. Those subjects who reported using air fresheners at home had significantly higher BMIs than those that did not use air fresheners (34.85±9.77 vs. 29.34±5.81, $p<0.05$).
Discussion: Of the reported chemical exposures, home use of air fresheners was the only one found to correlate with a higher average BMI. While an association of this nature does not establish causation, it generates a hypothesis for further research and laboratory investigations.
Conclusion: The association of air freshener use with obesity seen in this population should motivate further investigation to see if air fresheners may contain obesogens.

72. Medication Use of Chronically Ill Gulf War Veterans Presenting to a Medical Toxicology Clinic over 20 Years After the Conflict

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Background: Thirty percent of veterans of the 1991 Gulf War developed a persistent illness now known as Gulf War Illness (GWI), with chronic pain, chronic fatigue, and neuropsychological disabilities that are treated with a variety of medications of unknown efficacy.
Research Question: How effective is medication use in GWI subjects compared with those who take no medications?
Methods: An observational study of medication use was conducted. A case definition of GWI was used to screen potential subjects. Veterans responding to advertisements gave informed consent for a screening telephone interview. Veterans meeting inclusion criteria were scheduled for a clinic visit at a medical toxicology clinic. Standardized history and physical examinations were performed; medication use was recorded; an exposure history was taken, and symptoms were scored using a 10-cm visual analogue scale. Means+standard errors of visual analogue scores were calculated and compared according to medication use. Statistical analysis compared groups using *t*tests. Institutional review board approval was obtained.
Results: Three hundred two veterans were screened. Fifty Gulf War veterans were enrolled. Most troubling symptoms were sleep disturbance, chronic fatigue, arthralgias, myalgias, irritability, difficulty with memory, headaches, difficulty concentrating, inappropriate anger, and nasal congestion. The only consistent finding on physical examination was rhinitis (100 %). Treatment histories included a variety of psychotropic, analgesic, and antiflammatory medications used to treat symptoms of GWI. Mean number of medications to treat symptoms was 1.9 and ranged from 0 to 11. Visual analogue scores were not significantly different for those taking more than two medications relative to two or less except for greater sinus congestion and joint aches in those taking two or more GWI medications. Symptoms scores for congestion were 37+33 versus 54+28 cm, $p=0.003$; scores for arthralgias were 56.4+33 versus 73.3+21, $p=0.004$.
Discussion: This observational study found no benefit from current empirical treatment of GWI.
Conclusion: Twenty years after the 1991 Gulf War, veterans presented with a consistent illness of chronic fatigue, chronic pain, and neuropsychological disabilities. Those taking > 2 medications were not improved and suffered greater joint pain and congestion. These observations suggest that more effective treatments for GWI are needed.

73. Altered Mental Status and Renal Failure Following Acyclovir Overdose

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Background: Acyclovir is considered a safe medication. In patients with underlying renal disease, acyclovir has been associated with renal and central nervous system toxicity in the setting of therapeutic dose and overdose. These adverse effects have not been described in young individuals with normal renal function.
Hypothesis: Acute acyclovir overdose can result in altered mental status and renal failure in the absence of preexisting renal disease or other chronic comorbidities.
Methods: This is a single patient chart review. A 23-year-old previously healthy woman with a baseline creatinine of 0.4 mg/dL underwent a cesarean delivery because of active genital herpes. She was ordered

acyclovir 590 mg IV every 8 h but was inadvertently administered 5.9 g IV, infused over 14 h. After the infusion was complete, the patient was lethargic with a significant drop in urine output. She was subsequently transferred to the intensive care unit.

Results: Within 10 h, the patient's creatinine rose to 1.7 mg/dL. The patient was given IV fluids and furosemide in conjunction with nephrology consultation. Despite these measures, the patient remained oliguric and serum creatinine continued to rise, peaking 4 days post-exposure at 4.6 mg/dL (Table), with evidence of fluid overload. Renal ultrasound was normal. Urinalysis was notable for dilute urine with 3+ blood and positive leukesterase; urine culture grew out yeast. Computed tomography and magnetic resonance imaging of the brain and cerebral spinal fluid studies were unremarkable. Because the patient was not responding to initial therapy, hemodialysis was performed. The patient underwent three hemodialysis sessions, with improvement in her renal function and mental status. Prior to discharge, she required treatment for hypertension. She was discharged on post-operative day 12 with a creatinine of 0.6 mg/dL with no neurologic deficits.

Discussion: Acyclovir-induced renal and central nervous system toxicity are rare and generally affect the elderly and/or patients with baseline renal insufficiency or chronic comorbidities. Physiologic changes that occur during labor and delivery as well as during the intra- and post-operative state may have contributed to toxicity in this individual.

Conclusion: This case report suggests that acyclovir-induced renal and central nervous system toxicity can occur in individuals without underlying renal disease.

Table (Abstract 73). Serum creatinine (milligrams per deciliter) by days and hours post exposure to acyclovir
(Baseline creatinine, 0.4 mg/dL[a])

Days post-exposure	Hours post-exposure	Creatinine (mg/dL)
0	10	1.7
	22	2.3
1	30	2.6
	40	3.4
2	50	2.8
	69	4.3
3	99	4.6
4	116	2.5
5	135	1.7
6	152	0.7

[a]Creatinine at both 9 and 23 h prior to initiation of acyclovir

74. An Inpatient Toxicology Service Leads to Increased Hospital Revenue by Significantly Increasing the Number of Transferred Poisoned Patients

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Background: The incidence of drug overdoses and poisonings has steadily increased over the past several years and is now the second leading cause of death for people aged 34–54 years. The benefits of care of patients with toxic exposures by medical toxicologists are intuitive; yet data demonstrating efficacy are lacking.

Hypothesis: We hypothesize that the presence of an inpatient medical toxicology service increases hospital revenue by promoting the transfer of poisoned patients for subspecialty care.

Methods: This is a retrospective study of a cohort of poisoned patients discharged from two similar tertiary care hospital located 2 miles apart between January 1, 2008, and December 31, 2012. One hospital has an active inpatient medical toxicology service with a dedicated toxicology unit. The other hospital has no medical toxicologist on staff. A search of our hospital system's electronic medical record by an honest broker was used to identify all discharged poisoned patients utilizing ICD 9 codes. Inclusion criteria: all patients with primary discharge diagnosis of "overdose," "poisoning," or "toxicity" with ICD-9 codes 289, 304, 305, 503, 850–869, 930–952, and 960–989. Exclusion criteria: age<14 years old, prisoner, and pregnant. Subjects that met these criteria were grouped by whether they were transferred to the hospital with the toxicology service versus those transferred to the hospital without a toxicology service.

Results: Table I summarizes the number of transfers and the amount of money charged for the care of the transferred patients.

Discussion: The two hospitals primarily admit a similar number of poisoned patients. The hospital with a toxicology service has a 59-fold increase in transfers of poisoned patients. As a result, there is an 181-fold increase in billing of poisoned patients for the hospital with an inpatient toxicology service.

Conclusion: The presence of an inpatient medical toxicology service increases hospital revenue by promoting the transfer of poisoned patients for subspecialty care.

Table (Abstract 74)

	Toxicology service	Non-toxicology
Number of poisoned patients admitted directly through the ED	666	613
Number of poisoned patients admitted via transfer	413	7
Amount charged for transferred patients (dollars)	32,925,483.00	181,330.40

75. Effects of Medical Toxicology Specialty Care on Length of Stay Following Hospitalization of the Poisoned Patient

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Background: The incidence of drug overdoses and poisonings has steadily increased over the past several years and is now the second leading cause of death for people aged 34–54 years. The benefits of care of patients with toxic exposures by medical toxicologists are intuitive; yet data demonstrating efficacy are lacking.

Hypothesis: We hypothesize that the presence of an inpatient medical toxicology service decreases length of stay for hospitalized, poisoned patients.

Methods: This is a retrospective study of a cohort of poisoned patients discharged from two similar tertiary care hospital located 2 miles apart between January 1, 2008, and December 31, 2012. One hospital has an active inpatient medical toxicology service with a dedicated toxicology unit. The other hospital has no medical toxicologist on staff. A search of our hospital system's electronic medical record by an honest broker was used to identify all discharged poisoned patients utilizing ICD 9 codes.

Inclusion criteria: all patients with primary discharge diagnosis of "overdose," "poisoning," or "toxicity" with ICD-9 codes 289, 304, 305, 503, 850–869, 930–952, and 960–989. Exclusion criteria: age<14 years old, prisoner, pregnant, admitted for withdrawal, admitted for alcohol intoxication, transfers, envenomations, and carbon monoxide toxicity. Subjects that met these criteria were grouped by whether they were treated by toxicologists versus those treated by non-toxicologists. R statistical package was used for data analysis. Chi-squared test was performed for categorical data. Non-parametric data were analyzed by Wilcoxon rank sum test. Medians and interquartile range were reported for continuous variables. The 95 % confidence intervals are reported for proportional variables.
Results: One thousand nine hundred seventy patients were identified, and 691 patients were excluded. Table I summarizes the results.
Discussion: Availability of inpatient psychiatric beds, which are commonly required after purposeful overdose once medically optimized, often limits a service's ability to disposition a patient. Staffing and administrative differences may significantly affect the outcome of interest. The non-toxicology service hospital may receive advice from the medical toxicologists who comprise the Toxicology Service group through the regional poison center, which may minimize treatment differences.
Conclusion: The presence of an inpatient medical toxicology service significantly decreases length of stay for hospitalized, poisoned patients.

Table (Abstract 75)

	Toxicology service	Non-toxicology	*P* value
N	666	613	NA
LOS (days)	2 [1–3]	3 [2–4]	<0.001
ICU admits (%)	274 (41.1 [37.4–45.0])	253 (41.3 [37.4–45.3])	1
Age (years)	38 [28–51]	41 [30–51]	0.072
Male gender (%)	304 (45.6 [41.8.–49.5])	302 (49.2 [45.2–53.2])	0.215
African American race (%)	112 (18.0 [15.1–21.4])	94 (15.6 [12.8–18.7])	0.258

76. The Many Faces of 'Molly'-Methylone, MDMA, and Other Substituted Amphetamines.

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Background: 'Molly' is a colloquial term that refers to what users believe is 'pure' MDMA (methylenedioxymethamphetamine, aka 'Ecstasy'), an empathogenic phenethylamine. In New York, 'Molly' has been reported to also contain a variety of chemicals including methylone, 4-MEC (4-methylethcathinone), MDPV (methylenedioxypyrovalerone), and other substances. Methylone is the beta-keto version of MDMA. Synthesized in 1996 as a potential antidepressant, it became widely known as a 'research chemical' and 'bath salt' and as of 2013 became a schedule I controlled substance. Methylone has been reportedly sold as 'Molly' or misrepresented as MDMA.
Purpose: To describe a cohort of patients hospitalized after use of 'Molly' including reasons for use, clinical course, and confirmatory testing results when available.
Methods: Retrospective review of patients hospitalized and evaluated by Medical Toxicology after reported 'Molly' use at an urban academic center over a 2-year period (11/2012–11/2014).
Results: Eleven patients aged 18–42 (mean age, 23 years), seven female and four male, were identified. Eight were admitted, and three required intubation and intensive care unit (ICU) care. Eight were tachycardic; two were hypertensive. All were agitated and/or delirious. Neuromuscular excitation was present in nine. Three were febrile on core temperature monitoring. Rhabdomyolysis occurred in nine. Acute intoxication typically resolved around 12 h (range, 6–24 h). Among ICU patients, length of stay ranged 4–6 days. Four had specific urine testing for cathinones; three tested positive for methylone (range 100–16,000 ng/ml), none for MDPV or mephedrone. Additionally, three tested positive for MDMA, two for MDA (methylenedioxyamphetamine), one for MDEA (methylenedioxyethamphetamine), and one for unspecified amphetamine. Eight had confirmed polysubstance use. Further investigation documented THC (6), cocaine (4), opiates (4), and ethanol (4). Ten were using recreationally, and one was a suicide attempt. Care was supportive with benzodiazepines, cooling and hydration as the primary therapeutic interventions.
Discussion: 'Molly' users were young and predominantly female in this cohort. Polysubstance use was common. The intoxication presented as a mix of sympathomimetic and serotonergic findings, similar to known empathogenic amphetamines.
Conclusion: The term 'Molly' describes a variety of chemicals with stimulant and hallucinogenic properties. Contrary to popular belief, 'Molly' often contains a variety of chemicals.

77. Inhalational Palytoxin Exposures Reported to the National Poison Data System

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Background: Palytoxin is one of the most potent toxins known. It is produced by the microalgae *Ostreopsis* and can result in death after consumption of fish containing the poison. Inhalational injury may occur after breathing sea air bordering microalgae fields or cleaning an aquarium containing the coral that produces the toxin. However, the frequency and location of inhalational exposures in the United States (U.S.), as reported to the National Poison Data System (NPDS), has yet to be evaluated.
Research Question: The purpose of this study was to evaluate the burden of inhalational palytoxin exposures reported to the NPDS.
Methods: The NPDS was queried for all inhalational palytoxin exposures reported to U.S. poison centers between 2005 and 2014. Data analyzed included demographic, exposure, clinical, and temporal characteristics.
Results: There were 39 cases of palytoxin exposure during the study period, of which 51 and 31 % were reported in 2012 and 2013, respectively. Most cases were unintentional environmental (n=15, 38 %), general (n=10, 36 %), or occupational (n=8, 21 %) exposures that occurred at the patient's residence (n=30, 77 %). Twenty-nine patients (75 %) were treated at a healthcare facility while six patients (15 %) were managed at home. The majority (n=33, 85 %) of patients reported or were expected to have no more than minor or moderate effects. Only one patient experienced major effects, and no deaths were reported. Of those for whom duration of clinical effects were recorded, almost half of the patients symptoms resolved within 24 h; no patients were symptomatic for greater than 1 week. The most common effects were fever, coughing/choking, dyspnea, nausea/vomiting, and tachycardia (Table). Patients were primarily treated with bronchodilators, oxygen, intravenous fluids, and irrigation (Table).
Discussion: Palytoxin remains a rare exposure in the U.S. The frequency of cases, however, necessitates better education about the dangers of coral containing palytoxin as well as other preventative measures for aquarium technicians and enthusiasts to prevent further exposures. Similar to other NPDS reviews, reporting

biases may occur, and the data presented here may not represent true frequencies.
Conclusion: The majority of inhalational palytoxin exposures are relatively benign. Standard treatments include supportive care and bronchodilator therapy

Table (Abstract 77)

Frequencies of clinical effects (top 10)			Frequencies of therapies (top 10)		
Clinical effect	*n*	%	Therapies performed	*n*	%
Fever/hyperthermia	23	59.0	Bronchodilators	8	20.5
Cough/choke	16	41.0	Fresh air	8	20.5
Dyspnea	16	41.0	IV fluids	5	12.8
Nausea/vomiting	7	17.9	Oxygen	5	12.8
Tachycardia	6	15.4	Dilute/irrigate/wash	4	10.3
Bronchospasm	4	10.3	Antibiotics	2	5.1
Chest pain	2	5.1	Antihistamines	2	5.1
Headache	2	5.1	Steroids	2	5.1

78. Metaxalone-Associated Serotonin Syndrome

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Background: Metaxalone has only recently been associated with serotonin syndrome. There are two preveiously reported cases in the peer reviewed literature and four cases that have been presented in abstract form.
Hypothesis: The mechanism of action of this centrally acting muscle relaxant is unknown; however, the observation of serotonin syndrome in patients with metaxalone overdose suggests a role in the serotonin pathway.
Case Report: (Case 1) A 29-year-old female with intentional overdose of metaxalone presented to the emergency department with altered mental status, seizure-like activity, hyperthermia, rigidity in the lower extremities, myoclonus, and hyperreflexia. Her medication list included paroxetine. She was intubated and sedated with benzodiazepines, and actively cooled. Serum paroxetine level was 23 ng/mL (therapeutic range, 20–200 ng/mL), and serum metaxalone level was 31 mcg/mL (peak plasma concentrations average 0.9 mcg/mL at 3.3 h following a single 400 mg oral dose). (Case 2) A 27-year-old male presented to the emergency department with altered mental status, rigidity in his lower extremities, myoclonus, and hyperreflexia. He reported having taken extra metaxalone. His medication list also included escitalopram. He was managed aggressively with IV boluses of diazepam, in total 80 mg, in the emergency department. Serum escitalopram level was 24 ng/mL with a therapeutic range of 21–64 ng/mL, and serum metaxalone level was 58 mcg/mL.
Discussion: The observation of serotonin syndrome with metaxalone overdose is growing in the literature. Previous authors have noted the structural similarity between metaxalone and linezolid. It is possible that this structural similarity results MAO inhibition by metaxalone. Direct MAOI activity by metaxalone has yet to be demonstrated. Of the six cases of metaxalone associated serotonin syndrome (two published, four presented in abstract form), only two report metaxalone levels, and none report therapeutic serum selective serotonin inhibitors (SSRI) levels associated with supratherapeutic metaxalone levels.
Conclusion: Two additional cases of serotonin syndrome associated with metaxalone overdose are added to the literature. These are the first cases to report therapeutic levels of SSRI in conjunction with supratherapeutic metaxalone levels.

79. #Music&Drugs+Tweets: How #Drugs and #Alcohol Are Being Talked About @ Music Festivals

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Background: In 2013, the electronic dance music (EDM) festival, Electric Zoo (EZOO), in New York City, was prematurely canceled due to two drug-related fatalities. The demographic attending EZOO commonly communicate through social media. We sought to contextually and thematically analyze drug-related social media posts from attendees of EZOO 2014, the following year.
Research Question: How are drugs and alcohol being discussed at EZOO?
Methods: This study is a qualitative retrospective analysis of Twitter and Instagram output geotagged to the location and dates of EZOO 2014 EDM festival. Posts were manually reviewed by two investigators and analyzed for agreement. Those related to drug and/or alcohol use were categorized based on general theme. Posts "encouraging drug/alcohol use" (ENC) included those suggesting the writer was under the influence of, supported consumption of, or advised a means of acquiring drugs/alcohol. Posts "discouraging drug/alcohol use" (DISC) made mention of intended sobriety or discouraged excess use of drugs/alcohol. "Nonspecific mentions of drugs/alcohol" (NS) made reference to drugs/alcohol but did not meet criteria for inclusion in the first two categories. Keywords referring to drugs or drug use were cross-referenced with UrbanDictionary.com and Erowid.com.
Results: EZOO generated 11,071 geotagged posts between August 28 and 31, 2014. Two percent (224) were determined to be drug-/alcohol-related. The majority of drug-/alcohol-related posts (68 %) were ENC while 15 % were DISC and 17 % were NS. Illicit drugs (most commonly MDMA), or its effects, were mentioned in 25 % of the drug-/alcohol-related posts. Drug confiscation and increased security presence were other common themes.
Discussion: Analysis of social media posts geotagged to an EDM festival location provides insight into attendee discussions of drug and alcohol use. Though drug/alcohol use comprises a small percentage of all posts, when mentioned, most posts promoted its use. Furthermore, many posts were aimed at evading drug detection.
Conclusion: Drugs and alcohol are an important topic in online conversations at EDM festivals. Understanding how drugs and alcohol are being discussed via social media at music festivals may be an important first step in establishing public health interventions to deter their use.

80. Characteristics of Acute Cottonmouth Envenomation from the ToxIC North American Snakebite Registry (NASBR)

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Background: Few data have been published detailing the acute manifestations of envenomation by *Agkistrodon piscivoris* (cottonmouth). We

describe characteristics of acute cottonmouth envenomation from prospective data within the ToxIC North American Snakebite Registry (NASBR). To our knowledge, no prospectively collected data exist in the scientific literature.
Research Question: What are the clinical characteristics of cottonmouth envenomations entered into the ToxIC NASBR?
Methods: Data reported to the NASBR between March 1, 2013 and November 10, 2014 were reviewed. The database was queried using the keyword "cottonmouth." Data collected included demographics, clinical and laboratory findings, treatments, and outcomes.
Results: Three sites contributed 11 cases of cottonmouth envenomations. Eight bites occurred in males. Six were in children age 7–12 years, one in a 16-year-old, and four in patients aged 19–65 years. Swelling was the most commonly reported clinical finding and occurred in all. Ecchymosis occurred in nine patients. One patient developed a PT>15 s, fasciculations, numbness, and paresthesias. Another developed hemorrhagic blebs/bullae, and a third patient developed a severe hypersensitivity reaction to the venom requiring steroids, epinephrine, and vasopressors and underwent fasciotomy. Eight bites occurred to the lower extremity, three to the hand or finger. Six patients developed soft tissue swelling extending beyond one major joint, one extending beyond two major joints; three did not cross a major joint, and no data were available for one patient. Ten patients were treated with a mean dose of 12 vials of CroFab. Four patients required hospital stays of 49–72 h; three required stays of 25–48 h, and two were discharged in <24 h. No LOS data were available for two patients.
Discussion: Cottonmouth envenomations are uncommon. Our prospective data were limited to 11 patients. Seventy-three percent of envenomed patients were male. Swelling and ecchymosis were the most common clinical symptoms. One patient developed a severe hypersensitivity reaction and also underwent fasciotomy while another developed atypical neurotoxic symptoms.
Conclusion: Cottonmouth envenomations can manifest with moderate to severe symptoms and may require inpatient medical management beyond 24 h.
*The ToxIC Snakebite Study (TICSS) group: Anna Arroyo-Plascencia, Vikhyat S. Bebarta, Michael C. Beuhler, Adam Bosak, Jeffrey Brent, Daniel Brooks, E. Martin Caravati, James D. Cao, Nathan Charlton, Steven Curry, Michael Darracq, William Dribben, Kimberlie Graeme, Spencer Greene, Kennon Heard, C. William Heise, Janetta Iwanicki, Aaron Min Kang, William P. Kerns II, Thomas Kibby, Joshua King, Ronald Kirschner, Kurt Kleinschmidt, Michael Levine, Rachel Levitan, Philip Moore, Michael Mullins, Ayrn O'Connor, Nancy Onisko, Angela Padilla-Jones, Tammy Phan, Frank LoVecchio, Anne-Michelle Ruha, Steven A. Seifert, Daniel J Sessions, Aaron Skolnik, Eric Smith, Meghan B. Spyres, An Tran, S. Eliza Halcomb, Evan S. Schwarz, Shawn M. Varney, Rais Vohra, Brandon Warrick, G. Sam Wang, Paul Wax, Brian J. Wolk

81. Determination of Respiratory Depression Measured by Capnography of Acutely Intoxicated Patients Presenting to an Urban Emergency Department

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Background: The standard of care for monitoring the respiratory status of patients with decreased sensorium has been pulse oximetry and clinical observation. Pulse oximetry does not adequately detect hypoventilation. The role of capnography in intoxicated patients is poorly described.
Research Question: We hypothesized that intoxicated patients may demonstrate signs of hypoventilation as determined by end-tidal-CO2 (ETCO2) monitoring.
Methods: This was a prospective observational study of intoxicated patients presenting to a single emergency department (ED) between June 6, 2014 and August 1, 2014. Research assistants monitored the ED for patients with possible intoxication with drugs/alcohol. Eligible patients were between ages 18–80 years, had a baseline Rikers Sedation Agitation Scale Score of <3, and the treating ED physician believed the patient's decreased sensorium was "possibly" or "probably" due to an intoxicant. Vital signs and ETCO2 readings were collected at baseline, 30, 60, 90, and 120 min, and then hourly. Hypoventilation was defined by an ETCO2>45 mmHg. End points were: (1) alertness for at least 60 consecutive minutes, (2) disposition to home or another hospital department, or (3) decompensating respiratory status requiring bi-pap or intubation.
Results: Seven hundred ninety-four patients were screened. Thirty-five met enrollment criteria. Six were excluded from analysis (five for errors in ETCO2 data collection; one had non-intoxication altered mental status). Of the remaining 29 patients, 20 were male. Ages were 19–54 years. Alcohol was an intoxicant in 15 patients. Other intoxicants included benzodiazepines, synthetic cannabinoids, cocaine, heroin, and diet pills. Five patients had exposure to >1 intoxicant. There were 19 episodes of hypoventilation; the lowest pulse oximetry was 95 %. Of the three patients with >2 episodes of hypoventilation, two used heroin and one, lorazepam. No patient received bi-pap or intubation.
Discussion: The optimal management of decreased sensorium-related hypoventilation is not clear. There is only one paper on the role of ETCO2; it focused on ethanol intoxicated adolescents. Our data include a broader age range and various intoxicants.
Conclusion: ETCO2 detected hypoventilation before pulse oximetry. It should be considered during the management of patients with intoxication-induced central nervous system depression.

82. Dermal and Inhalational Exposure to Paint Thinner Causing Methemoglobinemia

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Background: Methemoglobinemia is a well-known but uncommonly seen cause of cyanosis and hypoxia from oxidation of ferrous (Fe2+) to ferric (Fe3+) hemoglobin. There have been several case reports from ingestion of paint thinner, but it is not previously known whether it can cause methemoglobinemia from transdermal or inhalational exposure to our knowledge.
Hypothesis: Exposure to paint thinner in routes other than ingestion, such as inhalational or transdermal, can cause significant methemoglobinemia.
Methods: The patient is a 50-year-old man who was cleaning his paint brushes in a poorly ventilated room without gloves. The paint thinner he used contained 1,2,4 trimethylbenzene and petroleum-based Stoddard solvent. Within about an hour, the patient developed shortness of breath but no chest pain, and he noted a blue hue to his skin and called the paramedics. Upon arrival to the Emergency Department, his vitals were heart rate 118, blood pressure 103/66, respiratory 22, and O_2 saturation 88 % on 15 L non-rebreather. His appearance was noted for central cyanosis and ashen skin color, and his blood was dark. Given his critical respiratory status, an arterial blood gas was obtained and was noted to have 29.7 % methemoglobin. Given

the patient's weight, he was given 100 mg of methylene blue. Within 10 min, the patients color improved, and he was quickly weaned off oxygen. The patient was monitored overnight and discharged in the morning without incidents.
Results: Initial arterial blood gas showed pH of 7.42; PCO_2, 35 mmHg; PO_2, 210 mmHg, HCO_3, 24 meq/L; carbon monoxide level of 5.8 %; and methemoglobin level of 29.7 %. Repeat levels of methemoglobin were <1 % 4 and 8 h after treatment with methylene blue.
Discussion: To our knowledge, this is the first described case of methemoglobinemia caused by paint thinner exposure not from ingestion. Given the history, we cannot be certain if the exposure was transdermal or inhalational or both. This is an example for the use of proper personal protective equipment and well-ventilated areas when working with any chemicals.
Conclusion: Paint thinner may cause methemoglobinemia from dermal and/or inhalation exposure.

83. "Doc, Can I Have Something Stronger?" ED Prescribers' Perspectives and Practices Concerning Opioid Prescribing

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Background: Because of the importance of opioid analgesics in poisoning death, many have sought to understand the knowledge and practices of prescribers. Decisions to prescribe opioid medications are highly individualized; however, little is known about the influences on prescribing decision-making.
Research Questions: How do emergency department (ED) prescribers vary in their opioid prescribing practices for minor injury (ankle sprain and fracture), and do personal perspectives regarding pain management influence personal medication use?
Methods: This was a web-based descriptive multicenter survey using FluidSurveys. The survey instrument was iteratively developed and piloted. A cluster sample (7 of 30 centers) of the EDOPIOIDS consortium was randomly selected to participate. All prescribers at the selected centers were eligible to participate, including attendings, residents, nurse practitioners (NPs), and physician's assistants (PAs). Questions were included about prescribing practice for various acute and chronic pain syndromes, beliefs about the influence of regulatory changes on practice, and personal and family medication practices. Responses on prescribing for ankle injury based on patient type and personal use were reviewed and analyzed using descriptive statistics.
Results: Five hundred fourteen responses were collected from 957 potential respondents for an overall response rate of 53 %. Among respondents, 49 % were attendings, 40 % residents, 5 % NPs, and 5 % PAs. The table shows the number of respondents who would prescribe an opioid to different patients complaining of 10/10 pain from an ankle sprain and an ankle fracture. The 62.6 % of respondents reported having taken an opioid for relief of pain; of those, 48 % reported taking 1–2 pills, 34.3 % took less than half the pills, 12.8 % took more than half, 4.2 % took all the pills prescribed, and <1 % took none.
Discussion: The reported prescribing suggests that ED prescribers may treat themselves and their families with less opioids and then they prescribe for their patients. Almost half of respondents who were previously prescribed opioids used very few of the prescribed pills. Limitations of the study include non-response and recall bias among respondents.
Conclusion: Opioid prescribing practices were highly variable in this survey of ED prescribers. The different approaches to analgesia among the varying patient populations raise questions about shifting risk/benefit concerns and pain relief expectations

Table (Abstract 83). Number of respondents who would prescribe an opioid to a patient complaining of 10/10 pain from an ankle sprain or fracture by patient type

Patient type	Ankle sprain (%) (n=443)	Ankle fracture (%) n=439
Adult	93 (21 %)	378 (86 %)
Adult family member	61 (13 %)	327 (75 %)
Yourself	26 (5.8 %)	229 (52 %)
Your teenage child	18 (4 %)	186 (42 %)

84. 25i and 2C Substituted Phenylethylamine Exposures Reported to a Regional Poison Center

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Background: Novel synthetic "designer drugs", (2C-phenylethylamines (2C-series), and *N*-benzyl-phenylethylamines (*N*-Benzyl or 25i-Series) have become increasingly popular in the US. Built on a phenylethylamine backbone, these compounds exhibit both sympathomimetic and serotonergic effects leading to severe toxicity. Characterization of clinical effects and toxicity of these synthetic agents can allow for early identification and optimize care of intoxicated patients.
Hypothesis: Characterize the clinical effects of the 2C-series and the 25i-series phenylethylamines.
Methods: A retrospective cohort study of all single-substance exposures to the substituted phenylethylamines 25i and 2C-series reported to a regional poison center between 1 January 2005 and 30 September 2014 were examined. Descriptive statistics were generated for demographic data, products used, therapies administered, and medical outcomes.
Results: Eleven single-substance exposures (nine 2C and two 25i) were reported. The average age of patients was 19.4 years, ranging from 15 to 30 years, with 64 % males. The most common exposure route was ingestion (8, 73 %). Clinical outcomes were found to be mostly minor 54.5 % (n=6) and moderate 45.5 % (n=5) with no major outcomes or deaths. The most common clinical effects reported were agitation 36.4 % (n=4), hallucinations 27.3 % (n=3), and tachycardia 18.2 % (n=2). The most frequently implemented treatment modalities included benzodiazepines 64 % (n=7), and IV fluids 73 % (n=8). One case of 25i intoxication required bronchodilators 9 % (n=1) for bronchospasm, and a different case of 25i intoxication required intubation, mechanical ventilation, and intensive care unit care 9 % (n=1).
Discussion: Common clinical effects of agitation, hallucinations, and tachycardia are consistent with sympathomimetic and/or serotonergic activity of the novel synthetic phenylethylamines. One of the two patients reported with 25i intoxication required intubation while all of the 2C intoxicated patients were treated and released. Given the small sample size, comparable severity is unknown. This study is limited by the use of retrospective data, small sample size, and unknown drug dose.
Conclusion: Novel synthetic phenylethylamines have variable effects on serotonin receptors and have the potential for significant toxicity. More research is needed to characterize toxicity of the different classes of synthetic phenylethylamines to allow for more targeted treatment.

85. Are you experienced? A Survey of Synthetic Drug Use and Safety

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Background: Synthetic drugs, including cannabinoids marketed as "Spice" and "K2," were initially believed to have been safer than traditional illegal drugs due to their being sold legally and openly. The authors are unaware of any attempt to investigate whether the illegalization of these chemicals by Federal Law in 2012, and popularization of unpleasant effects in the media since their introduction may have tempered these beliefs.
Research Question: Do synthetic drug users, compared with non-users, perceive synthetic drugs as safer than traditional illegal drugs?
Methods: This is a cross-sectional survey of a convenience sample of emergency department (ED) patients. Participants in the subject group were selected from ED patients receiving a toxicology consult and reporting a history of synthetic drug use. Each participant in the subject group was paired with three age- and sex-matched participants in the comparison group, selected from ED all-comers who reported no synthetic drug use. Participants received an 11-question survey querying knowledge, use patterns, and beliefs about the safety of synthetic drugs. Statistical analysis was performed using a Chi-square test.
Results: Eighteen subjects were matched to 54 comparisons [n=72]. Participants were 83 % male [avg, 31; range, 18–61]. Sixty-seven percent of subjects, versus 89 % of comparisons, believed that synthetic drugs were not safer than traditional drugs [p=0.336]. Synthetic drug users reported a broader range of first drugs used than comparisons, cannabis most commonly (44 %), versus ethanol (56 %) for comparisons. Subjects were twice as likely as comparisons to know someone who used synthetic drugs. Fifteen percent of comparisons reported "thinking" about using synthetic drugs, and only 2 % of controls reported even seeing synthetic drugs actually available for sale compared with 100 % of users.
Discussion: The perception of synthetic drugs as safe has been supplanted by an understanding of their dangers. Unpleasant, noxious effects were better appreciated, either through experience, second-hand accounts, or popularized cases in the media. Limitations include those inherent to convenience sampling, small sample size, and accuracy of self-reporting illicit behaviors.
Conclusion: The majority of both groups thought synthetic drugs were more dangerous than their illegal counterparts. These differences were not significant between synthetic drug users and non-users.

86. Interfacility Transfer Times of Salicylate-Poisoned Patients in a Rural Poison Center Population

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Background: Salicylate overdose is a common presentation to emergency departments and may require hemodialysis for severe toxicity. In many rural settings, the need for hemodialysis necessitates patient transfer from one health care facility (HCF) to another with a higher level of care. Delays in this process can lead to worsened patient outcomes. No data are currently available regarding transfer times to help guide management of these patients.
Research Question: The purpose of this study was to determine the amount of time it takes to transfer a salicylate-poisoned patient from an institution without hemodialysis capability to one with the ability to perform hemodialysis.
Methods: This is a retrospective, consecutive-case review of all primary salicylate ingestions managed by a single poison center. The local PC database was queried for records of single-substance salicylate exposures involving patients who were transferred from one HCF to another for clinical management between 1/2003 and 9/2014. Cases were reviewed by two independent reviewers, and disparities were resolved by a third reviewer. Demographic, clinical, and exposure characteristics were assessed descriptively. Two time periods were evaluated, from when the PC recommended transfer to: (a) arrival at the second HCF and (b) when hemodialysis was performed.
Results: Eighty-four patients were identified. The majority was females (74 %), ages 13–19 (36 %), and ingested salicylates with suicidal intent (61 %). Need for dialysis was the reason for transfer in 28.6 % of cases, and ultimately, dialysis was performed on 15.5 % of patients. Average peak salicylate level was 49 mg/dl (95 % CI, 7.9–90.2 mg/dl). The median time between BRPC recommendations of transfer to arrival to HCF was 4.1 h (range, 0.4–23.8 h) [Table]. The median time between BRPC recommendations of transfer to performing hemodialysis was 19.6 h (range, 2.9–28 h).
Discussion: This study shows that the need for transfer places a significant delay in obtaining hemodialysis for patients with severe salicylate intoxication.
Conclusion: Transfer for hemodialysis or a higher level of care often takes several hours. Physicians without intensive care unit or hemodialysis capability should anticipate the need for transfer early and be aware of the prolonged time period before receiving further care.

Table (Abstract 86)

Clinical management	Transfer times					
Characteristic	*n*	%	Category	Patients with available data	Mean	SD
Reason for transfer			Time between PC recommendation of transfer to arrival time at next HCF			
Dialysis	24	28.6	Overall	65	317 min (5.3 h)	272 min (4.5 h)
ICU level of care	60	71.4	Patients with major clinical effects	12	404 min (6.7 h)	356 min (5.9 h)
Hemodialysis performed			Patients with moderate clinical effects	41	314 min (5.2 h)	202 min (3.4 h)
Yes	13	15.5	Patients where hemodialysis was performed			
No	68	81.0	Time between PC recommendation of transfer to arrival time at next HCF	11	363 min (6.1 h)	321 min (5.4 h)
Missing/unknown	3	3.6	Time between PC recommendation of transfer to performing hemodialysis	11	532 min (8.9 h)	409 min (6.8 h)

87. Pattern of Antivenin Use in Rattlesnake Bites Reported to Poison Centers

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Background: Rattlesnake bite is the second most common venomous snake bite reported to US poison centers, with over 1,300 reported in 2012.

Research Question: This study sought to examine the association of selected variables with the administration of antivenin (AV) in rattlesnake bites.

Methods: Cases were all rattlesnake bites reported to a state-wide poison center system during 2000–2013. Cases were divided into those with AV (treatment was reported to have been administered or recommended) and those without AV. The AV rate was determined for selected variables. When medical outcome was examined, the rate was determined for all outcome classifications and for not serious (no effect, minor effect, not followed-judged nontoxic, not followed-minimal effects) and serious (moderate effect, major effect, death, unable to follow-potentially toxic) groups.

Results: Of 1,633 total rattlesnake bites, the AV rate was 71 % and the serious outcome rate was 76 %. The AV rate by medical outcome was no effect, 3 %; minor effect, 42 %; moderate effect, 88 %; major effect, 97 %; death, 100 %; not serious, 37 %; and serious, 82 %. For patients already at/en route to a healthcare facility, the AV rate was 78 % and serious outcome rate was 77 %; for patients referred to a healthcare facility by the poison center, the AV rate was 22 % and the serious outcome rate was 77 %. The AV rate by patient age was highest for the 0–5 years age group, 89 %. The AV rate for the most common clinical effects was puncture/wound, 75 %; dermal edema, 85 %; dermal pain, 83 %; ecchymosis, 91 %; erythema, 84 %; other coagulopathy, 97 %; and prolonged prothrombin time, 95 %.

Conclusion: AV was reported in 71 % of the rattlesnake bites. Although patients referred to a healthcare facility by a poison center and those already at/en route to a healthcare facility had similar serious outcome rates, the former had a much lower AV rate. This may suggest that healthcare facilities are more likely to administer antivenin when poison centers might not consider such treatment necessary.

88. Gain Gains on Tide: Comparison of Pediatric Exposures to Two Laundry Detergent Pod Brands

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Background: The literature reports differences between exposures to Tide and All and Purex brands of unit dose laundry detergent pods reported to poison centers. In January 2014, a poison center system noticed the appearance of a new brand of laundry detergent pod, Gain Flings, that quickly surpassed All and Purex, but not Tide, pods in number of exposures.

Research Question: This study sought to determine whether there were differences between Gain and Tide laundry detergent pod exposures reported to poison centers.

Methods: Cases were all Gain and Tide laundry detergent pod exposures reported to a state-wide poison center system during January–October 2014 where the patient was age 5 years or less. The distribution of these exposures was determined for selected variables and comparisons made between the two brands.

Results: Of 1,076 exposures, 667 (62.0 %) involved Tide, 184 (17.1 %) Gain, 95 (8.8 %) All, 25 (2.3 %) Purex, and 105 (9.8 %) other/unknown brands. The 43.5 % of the Gain and 34.9 % of the Tide patients were 1 year old and 27.2 % of Gain and 31.9 % of Tide patients 2 years old; 48.9 % of Gain and 53.2 % of Tide patients were male. The most common exposure routes were ingestion (87.5 % Gain, 91.2 % Tide), ocular (13.6 % Gain, 12.6 % Tide), and dermal (10.9 % Gain, 7.6 % Tide). The management site was on-site (not healthcare facility) (59.8 % Gain, 56.4 % Tide), at/en route to healthcare facility (27.7 % Gain, 30.3 % Tide), and referred to healthcare facility (12.5 % Gain, 12.1 % Tide). The 9.8 % of Gain and 9.8 % of Tide exposures had serious outcomes (moderate or major effect, unable to follow-potentially toxic). The most common clinical effects were vomiting (48.4 % Gain, 42.3 % Tide), cough (13.0 % Gain, 11.4 % Tide), ocular irritation (9.8 % Gain, 9.4 % Tide), red eye (7.6 % Gain, 6.0 % Tide), drowsiness (7.1 % Gain, 4.3 % Tide), and nausea (6.5 % Gain, 3.6 % Tide).

Discussion: Gain and Tide laundry pod exposures differed by patient age and gender and route. The most common clinical effects were more frequently reported among Gain exposures.

Conclusion: In spite of these differences, the management site and medical outcome of Gain and Tide exposures were similar.

89. Antibiotic Use in the Management of Snake Envenomation

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Background: Snake envenomation produces inflammatory effects that may mimic and be difficult to distinguish from infection, including erythema, warmth, and inflammation of lymphatic channels. The incidence of infection is unknown but culture-proven infections are rare. There is no evidence that prophylactic antibiotics change the incidence of infection, and they are not recommended in the routine management of North American snake envenomation.

Research Question: Are health care providers administering prophylactic antibiotics to patients with snake envenomation?

Methods: Data reported to the ToxIC North American Snakebite Registry (NASBR) between March 1 2013 and October 31 2014 were reviewed. All cases were included. Data collected included patient demographics; physical findings; antibiotic use, doses, and purpose. Results are reported using descriptive statistics.

Results: Fourteen sites representing ten states across the US contributed 276 cases to the NASBR. Two hundred fifty-nine (94 %) had swelling, and 108 (40 %) had erythema. Twenty-eight (10 %) received at least one dose of antibiotics. Sixteen subjects were treated with antibiotics in the ED. Twenty-two received antibiotics while admitted as prophylaxis in nine and empiric treatment of erythema or suspected cellulitis in 11. Two patients received antibiotics for a documented infection; one was pre-existing and unrelated to the bite. The other patient developed extensive necrosis with digital nerve injury requiring multiple surgeries. Erythema was present in 15

(54 %) patients who received antibiotics and 94 (38 %) patients who did not receive antibiotics.

Discussion: Antibiotics are not routinely recommended in the treatment of North American snake envenomation, yet use in this cohort reported to the NASBR occurred in 10 %. Other reports have documented similar rates of prophylactic antibiotic use in North American snakebite, without demonstrated benefit. In this study, only one infection in a complicated case was confirmed. Unnecessary antibiotic use presents risks of adverse medication reactions, medication errors, drug resistance, and pseudomembranous colitis. Limitations of this study include no confirmation of infection or its absence, and follow up for late infection was not routinely performed.

Conclusion: Routine administration of antibiotics to snakebite patients continues despite published evidence and recommendations against the practice. Medical education regarding management of snakebites should include the appropriate use of antibiotics.

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90. Snakebite in the Elderly: A Retrospective Cohort of Patients Reported to the ToxIC North American Snakebite Registry

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Background: Epidemiologic studies of snakebite in the US report typical victims to be young men. While some pediatric studies exist, there is no literature focusing on a geriatric population.

Research Question: What are the characteristics, clinical course, and outcomes of elderly patients with envenomation by North American snakes?

Methods: Data reported to the ToxIC North American Snakebite Registry (NASBR) between March 1 2013 and October 31 2014 were reviewed. Inclusion criterion was age >65 years. Data included demographics, snake species, clinical and laboratory findings, treatments, and outcomes. Descriptive statistics were used.

Results: Fourteen sites representing ten US states contributed 276 cases. Twenty were >65 years (14, 66–79; 4, 80–89; 1, >89 years). Fourteen were men. Sixteen had co-morbidities; thirteen used cardiac medications and seven antiplatelet or anticoagulant medications. Bites were by 19 rattlesnakes and 1 unknown crotalid. Thirteen were upper and seven lower extremity bites. Time to healthcare was <2 h (n=19). All demonstrated swelling; eight had hemotoxicity (platelets <150 K/mm3 or fibrinogen <150 mg/dL), five thrombocytopenia (3<50 K/mm3), and five hypofibrinogenemia (4 below limit of detection). One had minor bleeding, one hypotension, one tachycardia, and one new atrial fibrillation. All received Fab antivenom (mean 9 vials, range 4–18). Hospital stay ranged 1–3 days. Six had ≥1 set of follow-up laboratory studies and absence of bleeding documented. Two were readmitted and retreated: one for swelling; the other twice, for recurrent coagulopathy 7 days post-bite and late thrombocytopenia 15 days post-bite. This patient did not take anticoagulant or antiplatelet medications, and hematology studies were normal 5 days post-bite.

Discussion: In this elderly cohort, co-morbidities and use of antiplatelet or anticoagulant medications, which have been associated with increased risk for early and late bleeding following snakebite, were common. No late bleeding complications were reported in this study, although only 30 % had follow-up for late hemotoxicity and bleeding documented. Ten percent of patients were readmitted and retreated. One study limitation is that follow-up may have been performed by non-NASBR participants.

Conclusion: Elderly patients with North American snake envenomation are likely to have co-morbidities and take medications that may increase their risk for bleeding and complications.

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91. The Bubbler Did It?: Methemoglobinemia Associated with Nitrate Exposure from a Water Fountain

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Background: There is an association between elevated nitrates/nitrites in drinking water and methemoglobinemia, particularly in infants. This association is less well described in adults.

Hypothesis: Testing of local water sources may reveal a possible etiology of methemoglobinemia in a healthy adult male.

Methods: A 32-year-old presented to the Emergency Department with acute onset of lightheadedness, dizziness, distal paresthesias, and nausea. He was noted to be cyanotic on presentation. His systemic symptoms improved 1 h after onset, but his cyanosis did not. He denied respiratory symptoms on presentation and throughout his course. Further history revealed the patient drank >1 L of water from a lobby water fountain at a partial inpatient mental health facility. He reported the water had a metallic taste and that other patients do not drink from the fountain for that reason. His only reported medication exposures were therapeutic doses of gabapentin, fluoxetine, risperidone, and intranasal fluticasone. Initial methemoglobin percentage was 16.3 % (Masimo rainbow® RAD 57). No methylene blue was given due to resolution of symptoms. The patient's methemoglobin percentage was 1.2 % on discharge less than 24 h later.

Results: Nitrate/nitrite levels were measured in samples from the offending water fountain 8 days later. A level of 180 mg/L (EPA regulatory limit 10 mg/L; WHO regulatory limit 50 mg/L) was

obtained. The testing of additional water sources in building yielded levels of 1.75 and 1.74 mg/L. The water fountain was removed from service on the original day of presentation.
Discussion: Well water containing nitrates/nitrites, particularly in excess of ~50 mg/L, is described as contributing to methemoglobinemia in infants. We report a relatively rare case of methemoglobinemia in an adult after a single, large-volume acute exposure to a high nitrate/nitrite concentration water source. In the absence of other apparent etiologies, testing of a water source revealed a possible etiology of disease and may have prevented future exposures.
Conclusion: Testing of a water source may reveal a possible etiology of acute methemoglobinemia in a healthy adult.

Table (Abstract 91)

Nitrate/nitrite levels (mg/L)	
Offending water fountain	180 mg/L
Alternative site in building #1	1.75 mg/L
Alternative site in building #2	1.74 mg/L
EPA regulatory limit	10 mg/L
WHO regulatory limit	50 mg/L

92. Butane Hash Oil Burns Associated With Marijuana Liberalization in Colorado

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Background: Butane hash oil (BHO), also known as "amber", "glass", "shatter", "wax", or "dab", is a potent marijuana concentrate, containing more than 90 % tetrahydrocannabinol. BHO is easily manufactured using highly volatile butane as a solvent.
Research Question: What is the prevalence of hydrocarbon burns associated with BHO manufacture since marijuana liberalization in Colorado?
Method: This was a cross-sectional study utilizing the National Burn Repository to capture all hydrocarbon burns admitted to the local burn center from January 1, 2008 through August 31, 2014. We abstracted medical records for patients admitted for hydrocarbon burns associated with marijuana for the following variables: demographics, total body surface area, degree and location of burns, types of injuries suffered, hospital length of stay, and types of interventions required.
Results: Twenty-nine cases of BHO burns were admitted to the local burn center during the study period. Zero cases presented prior to medical liberalization, 19 (61.3 %) during medical liberalization (Oct 2009–Dec 2013), and 12 (38.7 %) in 2014 since legalization. The majority of cases were Caucasian (72.4 %) males (89.7 %). Median age was 26 (range, 15–58 years). Nearly all explosions occurred within an enclosed space (91 %). The median total-body-surface-area (TBSA) burn size was 10 % (TBSA range, 1–90 %). Median length of hospital admission was 10 days. Most suffered a burn to an upper extremity (97 %) and/or a burn to the head or neck (66 %). Six required intubation for airway protection (21 %). Nineteen required skin grafting, 8 wound care only, 1 required surgical fracture repair, and 1 required surgical debridement.
Discussion: Liberalization and subsequent legalization of marijuana in Colorado has resulted in increased prevalence of hydrocarbon burns due to production of BHO. In this cohort, most patients were young, white men in their twenties. Patients burned approximately 10 % of their body, typically stayed in the hospital over 1 week, and required surgical intervention in more than 2/3 of cases.
Conclusion: Hydrocarbon burns associated with hash oil production have increased since liberalization of marijuana policy in Colorado. A combination of public health messaging, standardization of manufacturing processes, and worker safety regulations are needed to decrease the risks associated with BHO production.

93. Therapeutic Plasma Exchange and Liver Transplant for Acute Hepatic Failure Due to Iron and Acetaminophen Toxicity

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Background: To date, this is the first known case report of iron (FE)-induced and acetaminophen (APAP)-induced fulminant hepatic failure (FHF) treated with aggressive supportive care, standard antidotal therapy, and therapeutic plasma exchange (PEx) that received an orthotopic liver transplant and survived.
Methods: This is a single patient case report. A 16-year-old female presented 2.5 h after intentional ingestion of 125 multivitamin tablets containing 65 mg of elemental FE each and 100 APAP 500 mg tablets. She developed drowsiness, hematemasis, and hematochezia. Decontamination was not undertaken due to time of presentation and gastrointestinal bleeding. Initial KUB showed no radiopaque densities; 3-h post-ingestion (PI) FE concentration was 906 mcg/dL; 4-h PI APAP concentration was 145 mcg/mL, and initial liver function tests were within normal limits. Intravenous deferoxamine (DFO) was initiated at 15 mg/kg/h, and intravenous *N*-acetyl cysteine (NAC) was initiated with a loading dose of 150 mg/kg over 1 h followed by 12.5 mg/kg/h for 4 h then 6.25 mg/kg/h continuously. On HD 2, the patient developed FHF (Table 1). Daily PEx was initiated to correct the patient's coagulopathy and hyperammonemia. Fresh frozen plasma (FFP) was used as the replacement fluid. A liver biopsy on HD 4 showed 90 % hepatic necrosis. Standard antidotal therapy was continued in addition to vitamin K, lactulose, and FFP. She developed fever secondary to group a streptococcal bacteremia and required intubation on HD 7 for progressive encephalopathy and apnea. She underwent orthotopic liver transplant on HD 8 and was discharged on post-operative day 16 to an inpatient psychiatric facility in good condition.
Discussion: FHF secondary to FE and APAP is rarely described within the medical literature. In a previously described case series, all patients died despite maximal supportive care, including liver transplant. To our knowledge, this is the first report of FE- and APAP-induced FHF receiving liver transplant that survived.
Conclusion: We report survival after FHF secondary to FE and APAP toxicity receiving early antidotal therapy, maximal supportive care, and PEx, and ultimately, orthotopic liver transplant.

Table 1 (Abstract 93). Laboratory results and antidotal therapy

	HD 1	HD 2	HD 3	HD 4	HD 5	HD 6	HD 7
ALT units/L	1,823	7,260	2,259	2,353	740	372	156
AST units/L	1,341	7,200	2,836	763	140	28	17
Bilirubin mg/dl	3.5	5.5	4.3	7.4	9.7	13.3	12.4
INR	3.2	8.4	1.87	7.54	13.21	8.3	3.73
Ammonia mCmol/L	65	546	291	166	78	116	127
Iron mcg/dl	906 (max)	255	178	232	198	No data	No data
APAP mcg/ml	145 (4 h PI)	No data	<10	No data	No data	No data	No data
DFO	15 mg/kg/h	15 mg/kg/h	Discontinued				
NAC	6.25 mg/kg/h	6.25 mg/kg/h	6.25 mg/kg/h	6.25 mg/kg/h	6.25 mg/kg/h	Discontinued	
PEx		Once daily	Once daily	Once daily	Once daily	Once daily	Once daily

94. Pitfalls of Early Acetaminophen Concentrations in Prediction of Toxicity

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Background: Waiting to obtain a 4 h acetaminophen (APAP) level to apply the Rumack-Matthew nomogram following an acute APAP overdose is suboptimal in a busy over-burdened Emergency Department. Pharmacokinetic data show therapeutic APAP levels peak under 1 h, leading many to discuss the value of an early level to identify non-toxic ingestions. The reliability of such results in predicting toxicity in overdose is not established.
Hypothesis: A 1- to 4-h APAP level should not be used to predict toxic ingestions.
Methods: This is a case report of a 16-year-old girl who ingested 75 extra-strength (500 mg) APAP tablets in an attempt at self-harm. One hour later, she developed nausea and vomiting. The time of ingestion provided by the patient was consistent and corroborated by the parents. Initial labs, 75 min post-ingestion, revealed an undetectable (<2 mcg/mL) serum APAP level. There were no electrolyte or acid–base abnormalities, and transaminases were within normal limits. A 4 h, APAP level was 425 mcg/mL, and initial PT drawn at that time was 16.1 s. Intravenous *N*-acetylcysteine was then initiated. Prothrombin time peaked at 18.7 s. AST and ALT did not exceed 16 and 21 IU/L, respectively. *N*-Acetylcysteine was discontinued after 21 h without complication.
Discussion: This case is notable because a toxic ingestion of APAP produced an unmeasurable quantitative level 75 min after ingestion. Some authors have asserted that an APAP concentration <10 mcg/ml between 1 and 4 h post-ingestion can exclude significant overdose. A review of the literature revealed two studies investigating early APAP levels and prediction of toxicity. A 1994 retrospective review reported a 1 to 4 h acetaminophen level <100 mcg/mL to have a negative predictive value (NPV) of 94.6 % for excluding toxicity. A 2013 prospective study found the same conditions to have a NPV of 98.8 %. Including confidence intervals, this gave a false-negative rate of 6.5 %, leading authors to recommend against reliance on early acetaminophen concentrations to rule out toxicity.
Conclusion: This case highlights that reliance on a negative early acetaminophen level following an acute overdose may result in a missed toxic ingestion.

95. Electronic Mapping of Learning Activities in a Medical Toxicology Fellowship Program

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Background: The 2012 Core Content of Medical Toxicology outlines the areas of knowledge considered essential for practice of medical toxicology and serve as a template for development of fellowship curricula. Real-time tracking of topics covered may allow program director to identify topic areas taught and educational gaps.
Objective: To evaluate completeness of Medical Toxicology Core Contents in fellowship educational activities using purpose-build electronic data capture system.
Methods: Using Google Forms and Microsoft Excel, we developed an electronic form for recording topics that fellows had learned in each educational activity. Each topic covered was mapped to a specific item in the Medical Toxicology Core Content. A medical toxicology fellow recorded each educational activity in real-time, and the results populated an electronic database. We evaluated data from first 3.5 months of an academic year (July 1–October 15, 2014) and mapped the results to the six Major Categories and 196 topics of the Core Content.
Results: Data from 75 daily rounds and 65 other educational activities were analyzed. Daily rounds alone covered 102 of the 196 topics (52 %). For all activities, topic coverage increased to 140 topics (71 %). Category 2 ("Toxins and Toxicants") was the most covered (95 % of 40 topics) with the highest frequencies per covered topic (19.2 times/topic). Category 6 ("Analytical and Forensic Toxicology") was the least covered (47 % of 34 topics).
Discussion: During 3.5-month period, more than half of the Medical Toxicology Core Content was covered in daily teaching rounds, and other formal educational activities covered about half of the remainder. The database identified curriculum gaps to be addressed by supplemental educational activities and also topics that may be overtaught. Although generalizability of these results

is limited by inclusion of a portion of the academic year from a single program, this analysis demonstrates feasibility and utility of real-time tracking and analysis of educational activities.
Conclusion: In a medical toxicology fellowship program, clinically focused daily rounds cover about half of the Core Content in a 3.5-month period. It is feasible and useful to use electronic tool to track educational activities in real time and identify educational strengths and content needs.

Table (Abstract 95) Number of covered topics by educational activities and average frequency per each covered topics

Topic category	Number of topics			Average frequency/ covered topic
	Total	Covered with daily rounds (*n*, %)	Covered with all activities (*n*, %)	
Category 1: principles of toxicology	25	14 (56 %)	15 (60 %)	5.1
Category 2: toxins and toxicants	40	34 (85 %)	38 (95 %)	19.2
Category 3: clinical assessment	25	13 (52 %)	19 (76 %)	3.8
Category 4: therapeutics	33	22 (67 %)	27 (82 %)	7.4
Category 5: assessment and population health	39	7 (18 %)	25 (64 %)	1.8
Category 6: analytical and forensic toxicology	34	12 (35 %)	16 (47 %)	7.8
Total	196	102 (52 %)	140 (71 %)	8.9

96. Transdermal Patch Medication Exposures Reported to Regional Poison Center; Ten-Year Experience

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Background: Transdemal medication patches (TMPs) are designed as sustained-release drug delivery systems. To generate concentration gradient necessary for dermal absorption, the amount of drug in patch formulations is high. Therefore, TMP exposures may produce significant toxicity.
Research Question: Describe TMP exposures reported to a single regional poison center.
Methods: We performed a retrospective descriptive study of closed, single-substance, human exposures coded to TMPs from one regional poison center's data reported to the National Poison Data System (NPDS) from January 2005–October 2014 (118 months). Case counts were analyzed by product, route, age, gender, exposure reason, clinical effects, therapies, and level of health care facility.
Results: Four hundred twenty-four exposures were reported. Females predominated with 227 calls (54 %). One hundred thirty-eight calls (33 %) were age less than or equal to 5 years. The most frequent substances were fentanyl (128 calls, 30 %), nicotine (95 calls, 22 %), and salicylic acid (84 calls, 20 %). Main exposure routes were oral (197 calls, 46 %) and dermal (195 calls, 46 %). There were 262 (62 %) unintentional exposures, 79 (19 %) intentional exposures, 75 (17 %) adverse drug reactions, and 8 (2 %) with other reasons. More than half (240 calls, 57 %) were symptomatic. The most common clinical effects were nausea, vomiting, and drowsiness/lethargy. No deaths were reported. About one-third (164 calls, 39 %) needed medical evaluation at health care facilities; 48 (11 %) were admitted. Twenty-one patients (5 %) were admitted to intensive care units (ICU) with most (19/21, 91 %) being fentanyl patch exposures. Seven of these required intubation.
Discussion: Although only 19 % of the calls were identified as intentional, more than half of all exposures were symptomatic. Providing education on safe use and disposal of TPMs to patients and care givers may reduce the incidence of toxicity from these formulations. Fentanyl patch exposures were the most common substance and resulted in significant toxicity. Clinicians should be aware of the fentanyl toxicity risk even from "used" patches and give appropriate management with including extended observation periods.
Conclusion: From one regional poison center, the majority of TPM exposures were related to fentanyl, nicotine, and salicylic acid. Most of ICU admissions and intubations were related to fentanyl patches.

97. Brom(ism)ance: An Escalating Relationship with Dextromethorphan

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Background: Dextromethorphan (DXM) is an over-the-counter antitussive agent commonly abused for its NMDA receptor antagonism and dissociative effects similar to phencyclidine and ketamine. DXM is found in multiple formulations, and is widely available as a hydrobromide salt (DXM HBr). The serum bromide elevation common to DXM HBr overdoses has previously been described as falsely elevating serum chloride. Tolerance and dependence have not previously been established in DXM users.
Hypothesis: Chronic DXM HBr abuse and tolerance may lead to escalating doses. This tolerance may be demonstrated by a gradual increase in the spuriously elevated serum chloride.
Methods: We describe an adult male who frequently presented to an urban academic emergency department (ED) following recurrent use of a single DXM HBr formulation. Initial serum chloride concentrations at each visit for DXM HBr ingestion were compared over time via linear correlation.
Results: Twenty-eight visits were included over 62 months from the first ED presentation. Chloride concentrations were available for 23 of those visits. Chloride concentrations ranged from 104 to 126 mmol/L. Correlation using chloride (y-axis) and months from first ED visit (x-axis) revealed $R2=0.6321$ ($p<0.001$); slope= 0.238; standard error of the slope=0.041 (for every increase in month number, there was an increase in chloride of 0.238 ± 0.041 mmol/L).
Discussion: Linear correlation indicates an increase in measured serum chloride that is unlikely due to chance alone, in the setting of recurrent DXM HBr abuse. These results suggest the development of tolerance and a need for escalated doses of DXM HBr. The patient confirmed a subjective need to escalate his dosing over the 5-year study period. This laboratory phenomenon has face validity but has not previously been evaluated from a laboratory standpoint. This patient experience is compelling both in theory and by statistical evaluation, but further study with similar assessment of many chronic DXM-abusing patients could establish a clearer link between abuse and tolerance.

Conclusion: Over a 5-year period, this patient's serum chloride (i.e., bromide) concentration demonstrated a gradual increase, suggesting the development of physical tolerance.

98. Single-Drug Exposures Associated with Rhabdomyolysis—A Review of the ToxIC Registry

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Introduction: Drugs and toxins are often cited as a cause of rhabdomyolysis, but there are little data regarding which xenobiotics are commonly implicated. Our objective is to characterize single-drug ingestions associated with rhabdomyolysis.
Methods: In this retrospective review of the Toxicology Investigators Consortium (ToxIC) registry, a search was completed for documented cases of rhabdomyolysis between January 2010 and September 2014. Cases were defined by creatine phosphokinase (CPK) >1,000 IU/L and were excluded if there was exposure to two or more xenobiotics. Individual xenobiotics, drug classes, demographics, signs, treatments, and outcomes including death were described.
Results: Two hundred twenty-five patients met inclusion criteria. Of these, 71 % were male and 80 % were between 19 and 65 years. Of the 75 different xenobiotics that were associated with rhabdomyolysis, methamphetamine was the most common, representing 14 % of all cases. Other common agents included diphenhydramine (7 %), heroin (6 %), and ethanol (5 %). Common drug classes associated with rhabdomyolysis were sympathomimetics (30 %), opioids (17 %), anticholinergics (8 %), and sedative-hypnotics (6 %). Forty-two percent of cases involved exposure to illicit drugs of abuse, and 31 % of cases were associated with prescription medications. On presentation, 43 % had agitation, 38 % had CNS depression, and 30 % had delirium or toxic psychosis. Of all patients, 25 % had acute kidney injury (creatinine>2.0 mg/dl). CPK concentration was reported in 30 cases and ranged from 1,000 to 269, 816 IU/L. Pharmacologic support included benzodiazepines (47 % of cases), antipsychotics (9 %), and vasopressors (8 %). Four percent of patients received hemodialysis; 2 % received continuous renal replacement therapy, and 2 % received urinary alkalization. Seven patients died, representing an overall mortality of 3 %.
Discussion: Seventy-five different xenobiotics were associated with rhabdomyolysis in single-drug exposures. These are associations only, as we are unable to discern the direct cause of rhabdomyolysis in each case. Possible drug-related etiologies include direct myotoxicity, psychomotor agitation as seen with sympathomimetics or anticholinergics, or muscle ischemia from direct pressure in patients with CNS depression from sedative, opioid, or ethanol intoxication.
Conclusion: Common xenobiotics associated with rhabdomyolysis include sympathomimetics, opioids, anticholinergics, and sedative-hypnotics. Providers should be aware of this association and consider screening for rhabdomyolysis in patients with these ingestions or exposures.

99. Do Good Samaritan Laws and Laws Expanding Naloxone Access Decrease Opioid Death Rates?

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Background: Rising opioid abuse and opioid death rates in recent years have been well documented. Laws to expand naloxone access and provide immunity to individuals calling 911 have been promoted to prevent opioid deaths. In Colorado, a Good Samaritan law passed in 2012 and a third-party naloxone prescribing law passed in 2013. Studies comparing opioid death rates before and after implementation of these types of laws have been limited.
Hypothesis: With programs prescribing naloxone, opioid death rates in Denver County will decrease following implementation of a Good Samaritan law and further decrease with a third-party naloxone prescribing law.
Methods: This is a retrospective observational research study comparing the opioid death rate before and after implementation of a Good Samaritan law and a law expanding naloxone access. Numbers of deaths due to opioids were obtained from the Denver County (CO) Medical Examiner's Office from January 2008–September 2014. Numbers of estimated opioid exposures in Denver County were obtained from the National Poison Data System. Local programs prescribing naloxone provided numbers of naloxone prescriptions and reversals.
Results: The opioid death rate in Denver County decreased initially following implementation of a Good Samaritan law but increased following implementation of a naloxone third-party prescribing law. Opioid death rates stayed steady at 19–21 % from 2010 to 2012, with a fall to 13 % in 2013 and a rise to 26 % in 2014, despite a rise in naloxone prescriptions and reversals in 2014. Death rates rose from 18 % in 2008 to 45 % in 2009 with no explanation.
Discussion: Our study showed an initial decrease in the opioid death rate following implementation of a Good Samaritan law but no immediate reduction following a law expanding naloxone access. Given the complexity of opioid abuse, multiple factors contribute to opioid deaths. Multi-faceted interventions in other states have shown decreases in total opioid deaths. This study is limited by the time frame, the accuracy of reported naloxone reversals, and the small sample size.
Conclusions: Laws to expand naloxone access and provide immunity when calling 911 may not be enough to decrease the opioid death rate. Further assessments of interventions are warranted.

Table (Abstract 99). Opioid deaths, naloxone Rx and reversals by year Table (Abstract 100)

Category/year	2008	2009	2010	2011	2012	2013	2014
Opioid exposure calls (*n*)	154	125	126	156	146	134	102
Opioid related deaths (*n*)	28	56	24	33	31	17	27
Death rate (%)	18.2 %	44.8 %	19.1 %	21.2 %	21.2 %	12.7 %	26.5 %
Naloxone Rx to opioid users (*n*)					54	89	57
Naloxone Rx to third parties (*n*)						40	107
Reported naloxone reversals (*n*)					12	41	82

100. Blood Pressure Effects of Labetalol in Sympathomimetic-

UDS (+) substance	Case 1 cocaine	Case 2 cocaine	Case 3 cocaine	Case 4 meth/amphetamine
Age (years), sex	59, female	37, male	49, female	55, male
ICH location, volume	Lobar with IVH, 55.3 mL	Deep with IVH, 11.0 mL	Deep with IVH, 35.3 mL	Brainstem with IVH, 10.5 mL
Home beta-blocker	Metoprolol	Carvedilol	None	None
Pre-treatment BP #1 (HR)	220/110 (116)	221/151 (76)	242/102 (54)	203/160 (111)
Treatment #1	Labetalol 20 mg IV	Labetalol 20 mg IV	Labetalol 20 mg IV	Labetalol 10 mg IV
Post-treatment BP #1 (HR)	206/120 (89)	233/132 (83)	190/96 (52)	209/153 (113)
Pre-treatment BP #2 (HR)		195/126 (78)	190/96 (52)	182/132 (107)
Treatment #2	Changed to nicardipine	Labetalol 40 mg IV	Labetalol 40 mg IV	Labetalol 10 mg IV
Post-treatment BP #2 (HR)		226/137 (79)	181/108 (52)	206/138 (111)

UDS urine drug screen, *IVH* intraventricular hemorrhage, *BP* blood pressure, *HR* heart rate, *IV* intravenously

Associated Intracerebral Hemorrhage: A Case Series

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Background: Both sympathomimetic drugs and hypertension have been associated with worse outcomes in patients with intracerebral hemorrhage (ICH). Use of beta-blockers in sympathomimetic-associated cardiac events is controversial due to concern for an unopposed alpha effect and worsening hypertension. Very little data exist regarding this concern for sympathomimetic-associated neurologic events.
Research Question: What is the effect of beta-blockers when used as initial management of hypertension in the setting of sympathomimetic-associated ICH?
Methods: We performed a retrospective study of primary ICH occurring in 2009–2011 at our large academic center. Cases were identified by ICD-9 code and verified by physician review. Demographic data, vital signs, antihypertensive treatment, and imaging characteristics were recorded. Medical record review included history of sympathomimetic use within 24 h of presentation and results of urine drug screens (UDS). Cases associated with sympathomimetic drugs were screened for initial antihypertensive treatment with beta-blockers. Detailed chart review of selected cases was performed for serial vital signs and medication administration.
Results: We identified 424 patients with primary ICH in 2009–2011. The median Glasgow Coma Scale (GCS) was 14 (10, 15), and median ICH volume was 12.6 mL (3.9, 35.0). Median systolic blood pressure (SBP) was 173 (152, 206) and diastolic blood pressure (DBP) was 94 (80, 110). Of the 424 patients, eight (1.9 %) had reported history of recent sympathomimetic use or UDS positive for cocaine or amphetamines/methamphetamine. One patient with amphetamine-positive UDS was excluded due to prescribed Adderall. Of the seven remaining patients, the median GCS was 7 (3, 12); median ICH volume was 35 mL (11.0, 55.3); median SBP was 206 mmHg (157, 236), and median DBP was 121 mmHg (109, 133). Four of these patients received beta-blockers as initial blood pressure management (see table).
Discussion: In this case series, use of labetalol as initial treatment for severe hypertension in the setting of sympathomimetic-associated ICH appears to be ineffective. In some instances, blood pressures increased after administration of labetalol, which supports a concern for unopposed alpha effect when beta-blockers are used in the hyperacute setting.
Conclusion: These exploratory data suggest the need for further research on the role of beta-blockers in the treatment of sympathomimetic-associated ICH.

101. Protracted Coma Following 1,4-Butanediol Toxicity Treated with Fomepizole

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Background: 1,4 Butanediol (1,4BD) is metabolized to γ-hydroxybutyrate (GHB) via alcohol and aldehyde dehydrogenases. GHB toxicity includes central nervous system depression with rapid recovery within 1–3 h. Half-life of 1,4BD and peak plasma GHB level after ingestion has been reported as 39 min. There are no published reports of 1,4BD elevating osmolar gap or of iatrogenically prolonged 1,4BD half-life.
Hypothesis: Fomepizole may prolong elimination of 1,4 butanediol and extend associated coma.
Methods: This case report describes a 42-year-old woman who presented unresponsive. Initial vitals: BP 152/89, HR 58, T 97.7 F. Physical exam revealed myoclonic jerking and exaggerated startle. Anion gap (AG) was 19 and osmolar gap (OG) was 41.4 (corrected for serum ethanol of 150 mg/dL). Head CT was negative. She was unresponsive to naloxone or flumazenil. Upon transfer to toxicology, she was intubated for airway protection. She received 15 mg/kg of fomepizole for possible toxic alcohol ingestion. Repeat labs demonstrated AG 17, OG 29, and Cr 0.53. Ethylene glycol, methanol, isopropanol, and β-hydroxybutyrate levels were negative. Gas chromatography mass spectrometry urine drug screen revealed citalopram, ethanol, and nicotine. Electroencephalogram (EEG) showed burst suppression. Twenty-one hours after presentation, the patient's mental status rapidly improved and allowed extubation. She admitted ingesting "GHB" the previous evening. She had an uneventful course and was discharged home neurologically intact.
Results: Blood levels of 1,4BD at the time of fomepizole infusion and again 3 h later were 133 and 95 mg/dL, respectively. Calculated half-life of 1,4BD was 9.89 h, assuming a single compartment model and linear kinetics. Plasma GHB level was elevated at 510 mcg/mL.
Discussion: 1,4-Butanediol abuse has been previously described. Our case illustrates an unusual, misleading presentation highlighting the osmotic activity of 1,4BD. In addition, the half-life of 1, 4BD was prolonged manifold, presumably by alcohol dehydrogenase inhibition and delayed metabolism to GHB. This likely accounted for persistent osmolar gap early in the course,

prolonged coma, burst suppression on EEG, and abrupt recovery of mental status far later than expected.
Conclusion: Coma from 1,4-butanediol may be protracted after fomepizole administration.

102. Recurrent Neurotoxicity Following *Crotalus durissus terrificus* Envenomation Treated with Crotalidae Polyvalent Immune Fab (Ovine)

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Background: Envenomation by the South American rattlesnake *Crotalus durissus terrificus*, produces neurotoxicity (ataxia, paresthesias, ptosis, fasciculations, weakness, flaccid paralysis), systemic myonecrosis, renal failure, and coagulopathy. Native to Brazil, envenomation by this species in North America is rare, and species-specific antivenom is not readily available.
Hypothesis: Neurotoxicity may recur after envenomation by *C. durissus terrificus* despite treatment with ovine crotalidae polyvalent immune fab (C-AV).
Methods: In this case report, a 58-year-old man was envenomated by a captive *C. durissus terrificus* at the proximal third digit of the left hand during a feeding. He developed immediate pain, swelling, and ecchymosis at the bite site, had perioral paresthesias, and was given six vials of C-AV. Species-specific antivenom was not available. Initial laboratory values were normal except an elevated CK 320 IU/L. At 4 h, he developed hypofibrinogenemia and muscle fasciculations of his proximal legs and neck, prompting an additional six vials of C-AV. Paresthesias and fasciculations resolved after antivenom. CK peaked at 6,499 IU/L, and renal function remained normal. Hypofibrinogenemia progressed, reaching a nadir of <30 mg/dL with PT peak of 23.6 s and normal platelet counts. The patient was discharged 3 days after envenomation with hypofibrinogenemia; however, no bleeding complications occurred, and coagulopathy resolved 16 days post-envenomation. He was re-examined 6 days after envenomation for recurrent fasciculations of anterior thighs, neck, and abdomen. He was re-evaluated several times for intermittent fasciculations and pain and swelling of the envenomation site.
Results: Despite full laboratory improvement and negative imaging, sensory and motor symptoms persisted, with fasciculations seen on exam 34 days post-envenomation. Neurology consultation and subsequent EMG revealed ulnar and median nerve neuropathy of the left UE.
Discussion: This patient with *C. durissus terrificus* venom-induced neurotoxicity, rhabdomyolysis, and hypofibrinogenemia was treated with C-AV due to the unavailability of species-specific antivenom and anecdotal human data, animal, and in vitro studies suggesting benefit. Improvement in pain, paresthesias, and fasciculations appeared to correlate with antivenom administration. However, recurrence of neurotoxicity with intermittent fasciculations was notable and protracted.
Conclusion: This is the first report of recurrent and prolonged neurotoxicity following *C. durissus terrificus* envenomation despite treatment with C-AV.

103. Comparative "Penetrance" of a Regional Poison Control Center Versus Emergency Medical Services for Poisoning

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Background: People concerned about potential injury due to poisoning may seek help through a variety of avenues including calling a poison control center (PCC) or activating emergency medical services (EMS).
Research Questions: How often do residents of eastern Pennsylvania contact the PCC at The Children's Hospital of Philadelphia versus EMS for potential poisoning injury? Does this practice vary per geographic region within a state?
Methods: In this retrospective cohort comparison, PCC data were analyzed for the time period of 2011–2013. Eastern PA EMS poisoning-related data were similarly obtained from the National EMS Information System (NEMSIS). Penetrance, defined as the average number of cases generated per 1,000 people per year, was calculated for each of the 23 counties in the PCC's designated region for both EMS and PCC utilization (2010 census data).
Results: The PCC's overall penetrance in Pennsylvania was 6.42, with a county-specific range of 3.38–8.33. The EMS poisoning-related penetrance was 2.52 with a county-specific range of 0.54–6.40. The PCC penetrance data exceeded EMS penetrance in 22 out of 23 represented counties.
Discussion: Poison control center services have been shown to be cost-effective. This study compares the "penetrance" of the PCC versus EMS with regards to poisoning response in eastern PA. The PCC receives more human exposure poisoning contacts than EMS within the region, and this phenomenon appears largely stable on a county-by-county comparison. The relative cost-effectiveness of PCCs and EMS systems for poisoning response warrants analysis, and benchmarks for relative organizational penetrance merit establishment. Development of good collaborative efforts between PCCs and EMS may offer a potential for increased efficiency. Limitations include selection bias, misclassification, and failure to identify data existing in both databases. This study does not account for service consumers utilizing information or medical services beyond the PCC or EMS, such as the Internet or hospital emergency department.
Conclusion: The PCC has greater penetrance than EMS in eastern PA poisoning response.

104. Potential for Improved Collaboration Between State Emergency Medical Services and a Regional Poison Control Center

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Background: Poison center services are cost-effective. The Pennsylvania (PA) state-wide Emergency Medical Services (EMS) protocol states to "consider calling the poison control center" for poisoning-related cases.
Research Questions: To what degree does PA EMS use the services of The Poison Control Center at The Children's Hospital of Philadelphia (PCC), and is there potential for improved resource utilization through enhanced collaboration?
Methods: In this retrospective cohort comparison, PCC data were queried for human exposures coded as reported from EMS during 2011–2013. Eastern PA EMS poisoning-related data were similarly obtained from the National EMS Information System (NEMSIS). NEMSIS data do not track management site, clinical effects, or patient outcome.
Results: The PCC received a mean of 499 [95%CI, 479–520] calls per year initiated by EMS; the majority involved unintentional exposures. Among cases not already en route to a hospital, 70 % were managed on-site. The PCC's regional EMS received 19,499 [18,832–20,066] poisoning dispatches each year with approximately 3/4 due to drug poisoning. Age distribution of cases was disparate with 64 % of PCC cases, and 18 % of EMS cases, involving age <20 years.
Discussion: Eastern PA EMS utilized the PCC for only 2.6 % of their poisoning cases. When utilized, the PCC managed 70 % of cases on site, comparable to California data in which a PCC managed 68 % of EMS cases on site. As the PCC manages 80 % of childhood exposures, and 56 % of adult exposures, without hospital referral, it was extrapolated that the PCC might manage an upper-bound estimate of 2,700 EMS children and 8,900 EMS adults without hospital transfer each year. At $220–$500 per EMS transport, better utilization of the PCC by EMS could lead to

savings to the region's EMS system of $2.5 million–$5 million annually. Improved collaboration could save downstream hospital costs, reduce hospital crowding, and enhance PCC all-hazards surveillance. Limitations include selection bias, misclassification, and failure to identify data existing in both databases. The populations directly calling the PCC versus EMS may differ in clinically important ways.
Conclusion: There is considerable potential for mutual benefit from an enhanced collaborative relationship between EMS and the PCC.

105. Hemodialysis Is Likely Underutilized in Severe Aspirin Poisoning

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Background: Salicylate poisonings, despite having established treatment protocols, continue to result in a substantial number of analgesic-related poisoning deaths annually. Individual providers are unlikely to encounter many salicylate poisonings during their career. Concerns have been raised in the literature regarding nephrologists' recognition of the need for prompt hemodialysis in severe cases of salicylate poisoning.
Research Question: We aimed to examine the frequency that hemodialysis was performed in cases of significant salicylate poisoning and whether dialysis was associated with differences in mortality.
Methods: The National Poison Data System (NPDS), comprising all poisoning cases reported to United States poison centers, was queried for all significant single-agent aspirin poisoning cases between 2008 and 2012, defined as those with moderate, major, or fatal medical outcomes. Retrieved data included patient age, gender, chronicity of poisoning, reason for ingestion, clinical effects, and treatments performed. Data were analyzed via chi-squared analysis.
Results: The 8,568 cases of aspirin poisoning were identified, of which a total of 110 (1.3 %) resulted in death. Agitation, coma, diaphoresis, hyperthermia, tachypnea, seizures, and cardiac arrest were more prevalent in patients with death as opposed to major outcomes. In patients who died, hemodialysis was carried out in 25.5 % of cases versus patients with major outcomes in 36.9 % of cases (p=0.018) with a relative risk for death of 0.62. Patients with renal failure (defined as "clinically significant azotemia and loss of renal function" as judged by poison center personnel) were not significantly more likely to receive hemodialysis than those without renal failure. Intubation was carried out in 70.9 % of patients who died versus 26.3 % of patients with major outcomes. All other therapies (e.g., alkalinization, charcoal, parenteral fluids) were not significantly different between the two groups.
Conclusions: In our retrospective cohort, hemodialysis was associated with patient survival in cases of severe aspirin poisoning and was only utilized in 25 % of patients who died from aspirin poisoning. Hemodialysis may also be underutilized in patients with impaired kidney function and aspirin poisoning. Our results suggest that hemodialysis is underutilized in severe salicylate poisonings.

106. A Descriptive Study of Prescription Opioid Misusers Evaluated by Medical Toxicologists

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Background: Medical toxicologists have the unique opportunity to interact with patients who misuse prescription opioids and identify patient behaviors that can mitigate adverse outcomes.
Research Question: What are the demographics, drug use history, medication source, and other characteristics of patients presenting for emergency care after prescription opioid misuse resulting in medical toxicology consultation?
Methods: The Toxicology Investigators Consortium (ToxIC) Prescription Opioid Misuse subregistry is a prospectively collected, de-identified, national dataset of patients who required hospital admission and a medical toxicology consultation following prescription opioid misuse. Intentional self-harm patients were excluded. We descriptively analyzed medical history, drug use patterns, sources of medications, diversion factors, and other historical aspects that have been shown to increase misuse risk.
Results: Of 75 patient records reviewed, 50 % were between the ages of 30 and 50 years, 70 % were male, 59 % Caucasian, and 35 % Hispanic. Past medical and drug use history included 36 % reporting a chronic pain syndrome; 43 % misused alcohol (past and present); 47 % also used sedative-hypnotics; 56 % had used parenteral drugs, and 83 % had misused other prescription drugs. Additionally, 70 % reported history of treatment for drug (45 %) or alcohol (25 %) dependency. Reported psychiatric conditions included depression (38 %), anxiety (27 %), and developmental delay (20 %). Regarding the opioid that resulted in toxicology consultation, 36 % reported using oxycodone, 35 % buprenorphine, and 15 % hydrocodone, and only 35 % of these had a prescription. For those without a prescription, 78 % reported buying the drugs. Patients who reported recognizing their misuse problem identified the "turning point" as times when they missed important engagements (70 %), someone expressed concern (60 %), and problems at work (50 %) or with friends (50 %). Over 40 % reported co-ingestants including sedative-hypnotics (64 %), stimulants (18 %), heroin (7 %), and alcohol (3 %). The statewide prescription drug monitoring program was available and accessed in 70 and 49 % of cases, respectively.
Conclusions: In the population studied, most were either Caucasian or Hispanic males aged 30–50 years. Only one-third reported having a prescription, and co-ingestion of either alcohol or sedatives was common. Although the use of prescription drug monitoring programs is highly encouraged, less than 50 % of providers elected to do so.

107. Medical Toxicology Consult Service at a Tertiary Care Children's Hospital

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Background: While the proportion of toxicologists trained in pediatrics has decreased, over half of poison center calls involve children <6 years, and poisoning continues to be a common pediatric diagnosis. However, a bedside toxicology consultation service at children's hospitals is not common.
Aims: To describe the establishment of a pediatric medical toxicology consultation service at a tertiary-care pediatric hospital in collaboration with medical toxicologists from different departments and subspecialties.
Methods: In collaboration with Department of Pediatrics, Pediatric Emergency Medicine and Emergency Medicine, and our Toxicology Fellowship, we established a medical toxicology consulting service at our local tertiary-care children's hospital. Using billing and consultation records, we identified patients who received a consultation from August 1, 2013 to July 31, 2014.
Results: There were 139 consultations in the first year of service: Age range was 1 month to 18 years in a typical bimodal distribution (2 and

16 years), 67 % female. There were 14 (10 %) emergency department consultations, 62 (45 %) inpatient unit, and 63 (45 %) critical care unit. Common exposures included: 24 polypharmacy, 22 analgesics, 15 antidepressant/antipsychotics, 12 altered mental status, 9 anticholinergics, 7 envenomations, and 1 case of botulism. There were two deaths. The service rapidly generated 13 consultations in the first month, with a median of 11 consultations per month thereafter (range, 8–16). The service increased pediatric cases seen by the fellowship program from 30 to 94.
Discussion: In 2012, there were 386 calls from the children's hospital to the regional poison center. During our initial year, there were 440 calls, and we performed 139 bedside consultations. The acuity of patients was high; 45 % of consultations were admitted to the critical care unit. The service filled a clinical need that was immediately utilized by the medical staff and provided a more robust pediatric population for the toxicology fellowship.
Conclusion: In collaboration with medical toxicologists from different departments, a toxicology consultation service can be rapidly established and embraced at a tertiary care pediatric hospital. The service is disproportionately utilized for high acuity patients, increased utilization of our regional poison center, and increased toxicology fellow pediatric consultations.

108. Extracorporeal Membrane Oxygenation for Severe Toxicologic Exposures: Review of the Toxicology Investigators Consortium (ToxIC)

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Background: NPDS reported 2.3 million human exposure calls to in 2011 with 2,765 reported deaths (1.1 %). Although there have been many developments in treatments for severe exposures, one of the most aggressive supportive modalities is cardiopulmonary bypass, or extracorporeal membrane oxygenation (ECMO).
Aims: To describe use of ECMO for toxicologic exposures reported to the American College of Medical Toxicology (ACMT) Toxicology Investigators Consortium (ToxIC).
Methods: Retrospective review of the ACMT ToxIC registry from January 1, 2010 to December 31, 2013. Data collected included demographics, exposure, treatments, time to initiation, duration of ECMO, and survival.
Results: There were 26,271 exposures (60 % female) reported to the ToxIC Registry; 10 (0.0004 %) received ECMO including 4 pediatric (<6 years), 2 adolescent (6–18 years), and 4 adults (>19 years). Initiation of ECMO ranged from 4 h to 4 days into the hospital stay, with a duration from 15 h to 12 days. Exposures included: 4 polypharmacy, 3 chemical asphyxiants, 2 single drug ingestions, and 1 toxic alcohol. Medication classes included antihistamines (2), antipsychotic/antidepressant (2), cardiovascular drugs (2), analgesics (2), sedative/hypnotics (2) and antidiabetic (2). Most patients received other therapies including CRRT (5), bicarbonate (4), intralipid (2), and hemodialysis (1). Three ECMO patients received cardiopulmonary resuscitation during their hospital course. Survival rate was 80 %.
Discussion: Severe poisonings called to NPDS continues to increase, and poisoning has become the leading cause of injury death. In animal models and human case reports, ECMO has been showed to improve mortality from toxicity exposure to various xenobiotics. A previous case series reported similar survival rate (76 %). Unfortunately, ECMO requires a large amount of resources; few facilities have the capabilities or the ability to activate ECMO in a timely fashion, and it is associated with significant risks including stroke and infection.
Conclusion: ECMO was rarely used in poisoning cases seen by Medical Toxicologists and reported to the ToxIC registry. ECMO was utilized for all ages for pharmaceutical and non-pharmaceutical exposures. In most cases, ECMO was administered prior to cardiovascular failure, and survival rate was high. ECMO may be useful, if available, for severe poisonings, when standard supportive care is failing.

109. The Use of Insulin-Euglycemic Therapy by Medical Toxicologists

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Background: In 1999, it was first reported that insulin-euglycemia therapy might provide benefit for calcium channel blocker overdose. Since 2010, the Toxicology Investigators Consortium (ToxIC) Registry has collected detailed information on all clinical consults seen by a nationwide multi-center network of medical toxicologists. This Registry can readily provide information about medical toxicology practices.
Research Question: In cases of presumed single drug poisoning, what are the most common indications for medical toxicologists to use insulin-euglycemia therapy?
Methods: The ToxIC registry was queried between January 1, 2010 and October 30, 2014 regarding the use of insulin- euglycemia therapy. Singe-agent exposure cases treated with insulin-euglycemia therapy were identified and further analyzed by agent name and class, and by outcome.
Results: Of 34,466 cases in the Registry between January 2010 and October 2014 entered by 50 sites, 137 patients (0.4 %) received insulin-euglycemia therapy—45 single-agent cases and 92 multi-agent cases. The 45 single-agent cases were reported by 23 sites. Of these cases, 75 % involved calcium channel blockers (n=24) or beta blockers (n=10). Insulin-euglycemia therapy was used most commonly for diltiazem (n=10) and verapamil (n=7) poisoning. Insulin-euglycemia therapy was also used in cases of propafenone, quitiapine, trazodone, amitriptyline, opioid, and acetaminophen poisoning. There were five recorded deaths, one each from amlodipine, diltiazem, metoprolol, propranolol, and an unknown opioid.
Discussion: Data from the ToxIC Registry can readily be used to describe antidotal use by medical toxicologists.
Conclusions: Insulin-euglycemia therapy is most commonly used for calcium channel blocker and beta blocker poisoning, and is used in approximately 1 in 250 cases cared for by medical toxicologists.

110. A Pilot Program to Enhance Environmental Health Education in U.S. Medical Schools

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Background: Medical school curricula typically have little education on environmental health topics. Public health officials have become increasingly concerned about this lack of environmental health education and have sought solutions to introduce environmental health curriculum into medical student training and increase medical student awareness about environmental health.
Research Question: Can medical toxicology rotations in U.S. medical schools be used to increase medical student education on environmental health?
Methods: Ten U.S. medical schools with medical toxicology rotations were approached about joining a pilot program whose aim was to increase medical student awareness about environmental health. Each of these pilot sites was provided with seven online training modules on basic and advanced topics in environmental health. Sites were asked to incorporate these modules into their education program. Online pretests and posttests were used to assess knowledge gained, and student attitudes toward this

new program were recorded by means of an online survey. Students were resurveyed 6–12 months after completion of the rotation regarding the environmental health module impact.
Results: Seven online modules were developed during this pilot program covering topics on Taking an Exposure History, Reproductive Toxicology, Pediatric Asthma and Environmental Exposures, Endocrine Disruptors, Toxicology of Hydraulic Fracturing, Pesticide Residues in the Indoor Environment, and Particulate Matter and Public Health. From October 1, 2013 to September 30, 2014, the modules were viewed on 1, 132 occasions by students at nine of the ten medical schools. An overwhelming majority of the students reported that the online training provided information that had not previously been part of their education. A sampling of students 6–12 months after completion of the modules reported that 90 % of the participants believed the training enhanced their knowledge and awareness of environmental toxicology and that 64 % reported that their participation enhanced their ability to evaluate environmentally related illnesses.
Discussion: Online training modules can be used to expand content taught during medical toxicology rotations.
Conclusion: Medical toxicology rotations in U.S. medical schools can successfully be used to increase medical student education on environmental health.

111. Intentional Pharmaceutical Overdoses: Comparison of Self-Harm, Misuse/Abuse, and Therapeutic Misadventure ToxIC Case Registry Entries

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Background: Drug overdose due to intentional ingestion can be classified into three categories: attempt at self-harm (e.g., suicide), recreational misuse/abuse, or therapeutic misadventure. In 2014, the ACMT ToxIC Case Registry added these classifications to Intentional Pharmaceutical Poisonings. The ToxIC Registry includes all patients seen at the registered sites by a board-certified medical toxicologist.
Hypothesis: Cases of intentional pharmaceutical overdose would demonstrate a unique distribution of drug classes involved depending upon whether they were due to self-harm, misuse/abuse, or therapeutic misadventure, but the distributions of severity and treatments given would be relatively normative with regard to all types of intentional overdose.
Methods: Retrospective review (1/2014–11/2014) of the ACMT ToxIC Case Registry analyzing data from the intentional pharmaceutical overdoses. Analysis was performed using descriptive statistics and chi square comparisons across the three groups within intentional pharmaceutical overdose.
Results: Of 3,318 cases involving intentional pharmaceutical overdose, 71 % involved self-harm, 18 % misuse/abuse, and 11 % therapeutic use. Sixty-one percent were female. Type of ingestion and gender associations were significant ($p<.001$). Single-drug ingestions varied by type of ingestion (52 % of self-harm, 58 % misuse/abuse, and 68 % of therapeutic use) involving single drugs ($p<0.001$). Ingestions were also associated with drug class for analgesics (31 % of self-harm), antidepressants (20 % of self-harm), cardiovascular (18 % of therapeutic), anticholinergic/antihistamine, anticonvulsants (13 % of therapeutic use), and lithium (15 % of therapeutic) (p values<0.001). Antidotes use varied by intent ($p<0.001$). Type of toxicity was also associated with intent for cardiovascular, GI/hepatic, hematologic and renal/muscle ($p<0.001$), and pulmonary systems ($P=0.02$). Toxidromes were associated with intent, 40 % of self-harm toxidromes, sedative-hypnotic; and 30 % of misuse/abuse ($p<0.001$).
Discussion: The ToxIC Case Registry represents a novel mechanism for understanding the more severe types of poisonings. Identifying the agents responsible and illness severity from exposure may inform prescribing and preventative practices may lead to decreases in this type of exposure in the future.
Conclusions: Data from the ToxIC may help characterize the more severe type of intoxications associated with this type of ingestion.

112. Medications that Are Associated With Serotonin Toxicity: A Review of the ToxIC Registry

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Introduction: Serotonin toxicity is a syndrome of excess CNS serotonin that may lead to clonus, agitation, hyperreflexia, hyperthermia, and death. Though many case reports have documented medications that may be associated with serotonin toxicity, little systematic data have been collected regarding the medications associated with serotonin toxicity in medical toxicology practice.
Question: What medications are associated with serotonin toxicity?
Methods: We searched the ToxIC registry for all cases that listed "serotonin syndrome" as a toxidrome from the dates 1/1/2010–10/15/2014. The ToxIC registry contains prospectively collected clinical information on patients seen at the bedside by medical toxicologists. We searched the "agent name" to determine the medication or drug that was associated with the serotonin toxicity. Data were divided into cases with only one "agent name" listed and those with more than one "agent name." Only agents that were listed as "most consequential" to toxicity were included.
Results: We found 225 single-drug exposures and 385 multiple-drug exposures that were associated with serotonin toxicity (total 610). Of the single-agent ingestions, the most common agents were dextromethorphan (12 %), citalopram (11 %), sertraline (9 %), bupropion (8 %), and fluoxetine (4 %). Of the 385 multiple-drug exposures, the most common drugs noted were bupropion (18 %), citalopram (18 %), sertraline (12 %), venlafaxine (9 %), trazodone (9 %), and dextromethorphan (9 %). Serotonin toxicity was associated most commonly with these drug groups: antidepressants (379 cases; 247 SSRIs, 62 SNRIs; 70 bupropion), opioids (87 cases; 33 DXM; 30 tramadol; 23 fentanyl; 1 meperidine), stimulants (46 cases; 11 dextroamphetamine; 11 cocaine; 10 methylphenidate; 9 amphetamines; 3 MDMA; 1 desmethylphenidate; 1 mephedrone), antipsychotics (42 cases; 18 aripiprazole; 10 olanzapine; 6 haloperidol; 5 risperidone; 3 ziprasadone), and anticonvulsants (42 cases; 31 lamotrigine; 5 valproate; 2 topirimate; 2 carbamazepine; 2 oxcarbazepine). Serotonin toxicity was also associated with several less common, but noteworthy, substances: cocaine (12 cases), synthetic cannabinoids (7), MDMA (4), LSD (3), 25i-NBOMe (2), sufentanil (1), and mephedrone (1).
Discussion: Serotonin toxicity was most commonly associated with single-drug exposures to dextromethorphan and antidepressants. When associated with multiple-drug exposures, serotonin toxicity was most commonly associated with bupropion and citalopram, as well as stimulants, opioids, antipsychotics, and anticonvulsants.
Conclusion: The majority of cases of serotonin toxicity seen by medical toxicologists are associated with exposures to a small number of antidepressants, stimulants, and opioids.

Previously Presented and Previously Published Research: Poster Presentations

113. Daniel N, Kirschner RI, Lander L, Smith LM. Outcomes in suspected "missed" acetaminophen overdose. *Clin Toxicol* 2014; 52: 764.
114. Diaz JH. Is Haff disease palytoxin poisoning? *Clin Toxicol* 2014; 52: 731.
115. Kirschner RI, Lander L, Smith LM, Jacobitz KL. Nomogram line crossing in acetaminophen combination product overdose. *Clin Toxicol* 2014; 52: 695.
116. Klein LA, Bangh S, Cole JB. Retrospective evaluation of quetiapine abuse reported to the national poison data system. *Clin Toxicol* 2014; 52: 711.