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ANNUAL MEETING ABSTRACT

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Original Research: Platform Sessions

1. Snake Venom Binding Activity of Expired Antivenoms

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Background: Antivenoms are believed to have limited shelf lives. Research indicates antivenom activity may surpass expiration dates.
Research question: Does binding of antivenom to venom persist after expiration date?
Methods: Fluorescent immunoassays compared binding of antivenom to venom. Ninety-six well plates were coated with venom, incubated with antivenom, and then incubated with biotinylated anti-horse IgG. Streptavidin conjugated to β-galactosidase was added and hydrolysis of substrate generated fluorescence. Plates were analyzed using a fluorescent reader.
Results: Faboterapico Polivalente Antivipmyn Tri antivenoms with expiration dates of 1/00, 3/09, and 10/10 bound *Bothrops jararaca* venom at respective rates of 95, 68, and 73 %, relative to unexpired control. Soro Antibotiopico Laquetico antivenom with an expiration date of 01/00, bound *B. jararaca* venom at a rate of 141 % relative to unexpired control. Faboterapico Polivalente Antivipmyn Tri antivenoms with expiration dates of 1/00, 3/09, and 10/10 bound *Crotalus atrox* venom at respective rates of 115, 73, and 92 %, relative to unexpired control. Soro Antibotiopico Laquetico antivenom with an expiration date of 01/00 bound *C. atrox* venom at a rate of 147 % relative to unexpired control. SAIMR polyvalent antivenoms with expiration dates of 04/98, 04/03, 12/05, and 10/10 bound *Naja naja* venom at respective rates of 81, 81, 93, and 103 % relative to unexpired control. SAIMR Polyvalent antivenom with expiration dates of 04/98, 04/03, 12/05, and 10/10 bound *N. nivea* venom at respective rates of 88, 88, 100, and 106 %, relative to unexpired control.
Discussion: SAIMR antivenom binds *Naja* venom for at least 9 years after expiration. Soro Antibotiopico Laquetico antivenom binds *Bothrops* and *Crotalus* venom for at least 14 years past expiration, demonstrating in some cases, higher venom binding than unexpired antivenom. Faboterapico Polivalente Antivipmyn Tri retained some binding to *Bothrops* and *Crotalus* venoms, but not to the same degree as Soro Antibotiopico Laquetico. However, binding did not differ significantly among all lots of Faboterapico Polivalente Antivipmyn Tri. This study is limited by its in vitro nature and suitability for patient safety was not addressed.
Conclusion: Antivenoms from three manufacturers demonstrated equivalent binding to venom in vitro despite surpassing expiration dates.

2. Trypsin and Rosmarinic Acid Reduce the Toxicity of Eastern Coral Snake (*Micrurus fulvius*) Venom in Mice

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Objective: Since antivenom is expensive and not always available, alternative treatments for toxic bites and stings are needed. The efficacy of trypsin and rosmarinic acid (RA) in treating Eastern Coral Snake (*Micrurus fulvius*) envenomation in a murine model is determined in an in vitro model.
Hypothesis: Both trypsin and RA will reduce the toxicity of Eastern Coral Snake venom.
Methods: Design: randomized controlled blinded study. Subjects: Fifty mice (20–30 g). Study groups: Intraperitoneal injections of (1) 2 mg/kg *M. fulvius* venom (approximately twice the LD50 for mice, n=10), (2) 2 mg/kg *M. fulvius* venom incubated in vitro for 1 h prior to injection with RA at a 1:10 ratio (n=17), (3) 2 mg/kg *M. fulvius* venom incubated in vitro for 1 h prior to injection with 1 mg of trypsin (n=17), (3) 1 mg trypsin IP without venom (n=3), and (4) RA IP without venom (n=3). Mice were observed for 12 h for signs of toxicity. Main outcome: time to toxicity (respiratory distress (respiratory rate<25 breaths/min), loss of spontaneous locomotor activity, or inability to upright self). Statistical analysis: Time to toxicity using Tukey–Kramer honest significant difference and survival to 4, 6, and 12 h using chi-square analysis.
Results: Onset of toxicity: group 1, 120.3 min; group 2, 238.1 min (p=0.15 relative to group 1); and group 3, 319.7 min (p=0.007 relative to group 1). Group 3 but not group 2 survival to 4 h was significant compared to group 1 (p=0.023). Two mice in the trypsin group and one mouse in the RA group survived to 12 h. Mice receiving trypsin alone or RA alone survived to 12 h.
Conclusion: In vitro neutralization of *M. fulvius* venom by trypsin justifies progressing to an in vivo model in future studies.

3. Point of Care Testing in Setting of Nitromethane and Methanol Co-ingestion Will Not Mask True Creatinine, Anion, or Osmolar Gap

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Background: Nitromethane interferes with the Jaffé colorimetric reaction used to measure serum creatinine, potentially mimicking acute kidney injury. This lab interference may confound the clinical management of nitromethane exposure, especially when co-ingested with a toxic alcohol. Bedside point-of-care (POC) testing platforms measure creatinine by an enzymatic method, which may result in more accurate measurements. We further hypothesize that the anion and osmolar gaps remain unchanged in the presence of nitromethane.
Methods: Nitromethane was added to whole blood from healthy volunteers to achieve five concentrations (0, 0.25, 0.5, 1, and 2 mmol/L), and the following tests were performed: creatinine (Jaffé and POC), electrolytes (associated with Jaffé and POC), plasma osmolality, and nitromethane concentration (gas chromatography [GC]). The remaining samples were refrigerated for 7 days and reanalyzed by GC. Anion and osmolar

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gaps were calculated at each concentration. The proportional recovery of nitromethane and degradation of nitromethane were measured by GC. Data were analyzed for agreement with single-factor ANOVA. The magnitude of nitromethane interference on creatinine was assessed by linear regression.

Results: Mean creatinine for enzymatic and Jaffé methods were 0.93 vs. 0.76 mg/dL, respectively. Using the Jaffé method, the creatinine concentrations increased linearly with increasing nitromethane concentrations (R^2=1, p<0.01): creatinine (mg/dL)=7.1 × nitromethane (mmol/L)+ 0.79. With the enzymatic method, creatinine remained unchanged across the range of nitromethane concentrations (p=0.99). Anion and osmolar gaps also remained consistent. Nitromethane was reliably identified in all sample concentrations using GC on day 0. Detection of nitromethane at the 0.25 mmol/L concentration was not recovered in all samples on day 7. Nitromethane degradation was most pronounced at the 2 mmol/L concentrations with a mean 81 % recovery.

Conclusions: Nitromethane alters measures of creatinine using the Jaffé reaction in a linear fashion but not when using the enzymatic reaction. In the clinical setting of toxic alcohol exposure, a measured difference between Jaffé and enzymatic creatinine may identify the presence of nitromethane and may reliably estimate the nitromethane concentration. The presence of nitromethane did not result in alterations in the anion or osmolar gap. Retrospective nitromethane detection may be feasible after 7 days using GC.

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4. Internet Training Resulted in Improved Intern Performance in a Simulated Poisoned Patient as Measured by Checklist, But Not Global Assessment

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Background: Internet-based didactics can be used as a substitute for live teaching. However, there is little research on the effectiveness of internet-based teaching on outcomes relevant to clinical competence in medical toxicology. Medical simulation can measure competency in the management of poisoned patients. Simulation may be an ideal assessment tool for clinical competence, because it allows standardization of scenarios and no potential for patient harm.

Objective: In a population of emergency medicine (EM) interns, we measured the effect of brief internet-based training on resuscitation competence in a simulated opioid-poisoned patient.

Methods: We enrolled all eligible EM interns from two consecutive classes. The two groups were similar in background characteristics, including prior toxicology training, simulation experience, and EM training. All participants completed identical simulated poisoned patient scenarios during the first week of residency. The case, presented as an unknown, was a comatose opioid-poisoned patient. The case was adapted from a medical simulation textbook. One group of participants performed a brief internet-based training on management of toxicologic coma 1 week to 1 day prior to the patient simulation. The other group received no training. An unblinded rater scored participants' simulation performance with three validated tools—a simple checklist, a time-weighted checklist (which gives higher scores for faster completion of items), and a "global" scoring tool, which uses the rater's general impression of the participant's performance in various domains.

Results: Scores were compared using unpaired t tests. Using a simple checklist, internet-trained participants (n=12) had a mean score of 71.67 %, while untrained participants (n=11) had a mean score of 49.09 %. The difference in scores was 22.58 % (95 % CI, 1.59 %–43.56 %.) Using a time-weighted checklist, internet-trained participants had a mean score of 65.00 %, while untrained participants had a mean score of 38.18 %. The difference in scores was 26.81 % (95 % CI, 4.75–48.88). Using a global assessment score, the internet-trained participants had a mean score of 23.17, while untrained participants had a mean score of 22.45. The difference was 0.7122 (P>0.05).

Conclusion: A brief internet-based teaching module resulted in improved EM intern performance using checklist scoring, but not global weighted scoring, in a standardized simulated toxicology patient scenario.

5. Trends in Opioid Prescribing for Acute Headache in US Emergency Departments

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Background: Prescribing of opioid analgesics has risen dramatically over the past decade. Although not recommended by the American Academy of Neurology and the American College of Emergency Physicians' consensus guidelines as first-line therapy for acute headache, opioids are commonly used to treat this condition.

Research question: The purpose of this study is to assess the frequency of use and trends in opioid prescribing for headaches in US emergency departments (EDs) from 2001 to 2010.

Methods: A retrospective review of data from the Centers for Disease Control and Prevention's National Hospital Ambulatory Medical Care Survey (NHAMCS) 2001–2010 was performed. Visits for headache and head pain were identified. Medications used for the treatment of acute headache were identified and categorized based on medication class. Trends in ED prescribing of five common opioids (codeine, hydrocodone, hydromorphone, morphine, and oxycodone) were specifically explored. The proportion of visits for which each medication was prescribed or administered was tabulated and trends were analyzed using survey-weighted logistic regression.

Results: Visits for headache during which any of the five designated opioids were prescribed increased significantly between 2001 and 2010 (20.8 vs. 34.3 %, p<0.001). Prescribing of the individual drugs hydromorphone, morphine and oxycodone increased significantly, with the largest relative increase (454.1 %) noted with hydromorphone (1.7 to 9.5 %, p<0.001). Codeine utilization decreased from 2.3 to 2.0 % and hydrocodone use did not significantly change during the study period. Utilization of opioid alternatives, including acetaminophen, butalbital and nonsteroidal anti-inflammatory drugs (NSAIDS) did not change significantly. Prescribing of antiemetic agents decreased modestly whereas the use of intravenous fluids increased significantly. The estimated visits for acute headache increased from 5,539,206 in 2001 to 7,747,342 in 2010.

Discussion: Our analysis was limited because we could not account for the use of multiple medications during the same visit and the order in which medications were given. Future initiatives should focus on promoting the use of guideline-concordant agents for the treatment of acute headache in the ED and to promote rational prescribing of opioids.

Conclusion: Despite guideline recommendations, there was increased utilization of opioid analgesics for acute headache in US EDs over time. Antiemetic use declined, despite consensus recommendations endorsing their use.

Table (Abstract 5). Prescribing trends in medications used to treat acute headache, 2001–2010

Medication type	2001 prescribing (% visits)	2010 prescribing (% visits)	Percent change	*p* value
Acetaminophen	10.1 %	9.0 %	−10.8 %	0.827
Antiemetics	23.2 %	21.5 %	−7.4 %	0.019
Butalbital	1.9 %	2.4 %	23.3 %	0.829
IV fluids	20.3 %	33.5 %	64.7 %	0.001
NSAIDs	25.8 %	30.0 %	16.2 %	0.067
Opioids	20.8 %	34.3 %	64.9 %	0.001
Triptans	2.0 %	1.4 %	−29.2 %	0.123

Table (Abstract 6). Percent of visits during which an opioid analgesic was prescribed

Provider	Medication	2001–2002	2009–2010	% change	*p* value
Attending only	All opioids	18.0 %	24.1 %	33.8 %	0.001
	Schedule II	6.4 %	11.3 %	75.7 %	0.001
	Schedule III–V	11.3 %	12.6 %	11.6 %	0.098
Resident	All opioids	15.9 %	24.6 %	55.3 %	0.001
	Schedule II	6.8 %	11.7 %	73.2 %	0.001
	Schedule III–V	8.0 %	11.5 %	44.6 %	0.007
Midlevel provider	All opioids	20.0 %	25.4 %	26.6 %	0.003
	Schedule II	6.0 %	8.8 %	45.9 %	0.008
	Schedule III–V	13.8 %	14.4 %	4.9 %	0.682

6. Trends in Opioid Prescribing in US Emergency Departments Based on Provider Level of Training

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Background: Over the past decade, there have been significant increases in opioid analgesic prescribing. Variation in opioid prescribing based on provider level of training and specific opioids is less well characterized.
Research question: This study aims to assess trends in opioid prescribing based on provider level of training and specific agents in US EDs.
Methods: We reviewed all ED visits from the Centers for Disease Control and Prevention's National Hospital Ambulatory Medical Care Survey (NHAMCS) 2001–2010 involving patients ≥18 years. Trends in ED prescribing of all opioids stratified by Drug Enforcement Agency (DEA) schedule and provider level of training were analyzed. Prescribing trends for five common opioids (codeine, hydrocodone, hydromorphone, morphine, and oxycodone) were individually explored. Visits were stratified into three categories by provider level of training: those that involved an attending only, a resident or midlevel provider (nurse practitioners, physician assistants). The proportion of visits for which each medication was prescribed was tabulated and trends were analyzed using survey-weighted logistic regression.
Results: The weighted estimate of adult ED visits increased from 81,251,195 in 2001 to 100,027,879 in 2010 and the proportion of visits during which an opioid was prescribed by any provider increased from 10.0 to 19.0 %, $p<0.001$. Overall opioid prescribing increased for all visit types but was most pronounced in visits involving residents. Prescribing of schedule II agents increased more than schedule III–V agents for all groups (Table). Hydromorphone use increased the most for all provider groups (433.4–529.9 %, $p<0.001$), followed by morphine (139.7–219.9 %, $p<0.001$) and oxycodone (94.7–142.3 %, $p<0.001$). A variable effect was noted on codeine and hydrocodone prescribing among providers.
Discussion: Opioid prescribing increased dramatically in the past decade in the ED, and visits involving residents had the greatest growth. Although attendings may influence resident prescribing, these trends could reflect increased emphasis on pain management in training programs. Other forces such as patient experience and accreditation requirements could be driving overall prescribing rates higher.
Conclusion: There were significant increases in opioid prescribing among visits involving all providers over time, with hydromorphone demonstrating the greatest increase among the opioids studied. Visits involving residents showed the largest change among providers.

7. A 3-Year Analysis and Comparison of Opioid Prescribing Practices by Emergency Care Providers for Chronic Pain

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Background: Chronic pain is a common reason for emergency department (ED) visits. Emergency medicine providers commonly prescribe opioids; however, rates of opioid misuse have been high in the last several years. Previous studies have not described the variability in prescribing habits of emergency medicine providers.
Objective: This study aims to describe opioid prescribing practices for providers in an emergency department.
Methods: In our institutional review board-approved retrospective study, we evaluated opioid prescriptions from an emergency department at two military facilities between June 2009 and June 2012. We queried the outpatient record database to obtain a list of opioid medications prescribed and ICD-9 codes associated with ED visits for chronic pain. We also collected the number of pills prescribed, type of medication, and medication refill status. For statistical analysis, we compared the incidence and proportions with chi-square or Fisher's exact tests where appropriate. Wilcoxon test was used for nonparametric continuous variables. Data were reported as mean ± SD (median [IQR]). A $p<0.05$ was considered significant.
Results: Over a 3-year period, emergency care providers wrote 28,298 opioid prescriptions. A total of 3,936 (13.9 %) prescriptions were associated with a visit attributed to chronic pain. Providers were 49 % emergency physicians, 48 % physician assistants (PAs), and <1 % nurse practitioners (NPs). Medications prescribed were 40 % hydrocodone–acetaminophen, 35 % oxycodone–acetaminophen, 18 % codeine–acetaminophen, and 7 % other (tramadol, propoxyphene–acetaminophen, oxycodone, hydromorphone, and codeine). The average number of pills prescribed was 23±26 (20 [15–20]). Oxycodone–acetaminophen was more likely to have been prescribed by a physician than by a PA (65 vs 35 %) as was hydrocodone–acetaminophen (59 vs 41 %; $p<0.0001$). Codeine–acetaminophen was more likely to have been prescribed by a PA than by a physician (90 vs 10 %) as was tramadol (56 vs 44 %; $p<0.0001$). PAs prescribed a larger number of pills compared to physicians (26±23 vs 20±29; $p<0.0001$).
Conclusions: Physicians were more likely to prescribe opioids that were more potent and had higher risk for misuse (oxycodone–acetaminophen and hydrocodone–acetaminophen) compared to PAs. PAs prescribed more opioid pills per prescription and were more likely to prescribe tramadol and acetaminophen–codeine.

8. Buprenorphine/Naloxone Pediatric Ingestion: Exposure Rates Differ Between Film and Tablet Formulations

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Background: Buprenorphine ingestion can cause life-threatening poisoning in young children. Previous reports have found that film formulations are associated with lower pediatric exposure rates than tablet formulations.
Research question: The purpose of this study is to determine whether differences in pediatric exposure rates to different buprenorphine products are stable over time.
Methods: Data from Researched Abuse, Diversion, and Addiction-Related Surveillance (RADARS®) System Poison Center Program, January 2011–March 2013, involving unintentional exposure to buprenorphine sublingual tablets or film by children aged <6 years were analyzed. To adjust for medication availability, event ratios (rates) were based on the number of patients filling prescriptions for each formulation ("Unique Recipients of a Dispensed Drug", URDD). Negative binomial regression was used to produce quarterly rates, average rates, and 95 % confidence intervals (CIs).
Results: One thousand six hundred ninety-five reports were analyzed. Exposure rates for buprenorphine/naloxone combination tablets (7.0 exposures per 10,000 URDD (CI, 6.6–7.3)) exceeded those for buprenorphine monoingredient tablets (2.8 (CI, 2.4–3.2)) and combination film (0.9 (CI, 0.8–1.0)). The combination tablet and monoingredient tablet rates were significantly greater than film rates (rate ratios (RR): 7.6 (CI, 6.7–8.6; $p<0.0001$) for combination tablets and RR: 3.1 (CI, 2.6–3.7; $p<0.0001$) for monoingredient tablets compared with film). Relationships were consistent over time except for slight decreases in the monoingredient tablet rate.
Discussion: This study cannot determine whether the differences are caused by packaging or formulation. This analysis did not include generic buprenorphine/naloxone tablets, introduced in February 2013.
Conclusion: The rate of unintentional exposures to buprenorphine/naloxone sublingual film by young children is significantly less than the rate of exposure to buprenorphine/naloxone or buprenorphine monoingredient tablets.

9. Buprenorphine/Naloxone Abuse and Diversion: Film Rates are Less Than Tablet Rates

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Background: Buprenorphine is sometimes diverted and abused. Previous reports showed differences in diversion and abuse rates between formulations, but observation periods were short. This study extends the comparison of diversion and abuse rates between buprenorphine sublingual formulations.
Research question: Are buprenorphine diversion and abuse rates stable over time?
Methods: Data from the Researched Abuse, Diversion, and Addiction-Related Surveillance (RADARS®) System Drug Diversion (DD), Opioid Treatment (OTP), and Survey of Key Informants' Patients (SKIP) Programs were analyzed. The DD program captures new police investigations. The treatment programs (OTP and SKIP) collect patient reports of using a product "to get high" in the previous 30 days. Quarterly data from 2010Q4-2013Q1 (DD) and 2011Q2-2013Q1 (OTP/SKIP) were analyzed. To account for availability, event ratios (rates) were based on the number of patients filling prescriptions for each formulation ("Unique Recipients of a Dispensed Drug," URDD). Quarterly rates, average rates, and 95 % confidence intervals (CIs) were calculated using negative binomial regression.
Results: One thousand five hundred five diversion reports and 5,293 abuse reports were analyzed. Average diversion rates for buprenorphine/naloxone tablets (13.6 reports/10,000 URDD; CI, 12.8–14.5) and monoingredient tablets (8.7; CI, 7.6–9.8) exceeded the combination film rate (1.3; CI, 1.1–1.5) (rate ratio (RR) c/w film: 10.6 (CI, 9.0–12.4; $p<0.0001$) for combination tablets and 6.7 (CI, 5.5–8.2; $p<0.0001$) for monoingredient tablets). Average abuse rates for buprenorphine monoingredient tablets (61.8 reports/10,000 URDD; CI, 59.2–64.6) and buprenorphine/naloxone tablets (21.3; CI, 20.3–22.3) exceeded the combination film rate (9.1; CI, 8.7–9.6) (RR c/w film: 6.8 (CI, 6.3–7.3; $p<0.0001$) for monoingredient tablets and 2.3 (CI, 2.2–2.5; $p<0.0001$) for combination tablets).
Discussion: This analysis excludes generic buprenorphine/naloxone tablets, introduced in February 2013.
Conclusion: Diversion and abuse rates for buprenorphine and buprenorphine/naloxone tablets consistently exceed those of buprenorphine/naloxone sublingual film.

10. Sub-anesthetic Slow Infusion of Ketamine for Treatment of Depression Produces Rare but Currently Unpredictable and Potentially Serious Psychosomatic Effects

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Background: Ketamine has been associated with psychotomimesis, dissociation, and addiction. It is also used as a rapid-acting antidepressant at doses and infusion rates lower than those for anesthesia.
Hypothesis: Ketamine for treatment of depression may cause adverse psychosomatic effects, mental illness may confer greater risk.
Methods: Three concurrent prospective studies enrolled patients in open-label (unipolar depressives (UPs)) and placebo-controlled (UPs and bipolar depressives (BPs)) trials to receive single-dose ketamine 0.5 mg/kg IV over 40 min. Serious medical conditions were exclusionary. No CNS-active agents were permitted for 18 days before infusion. Brief Psychiatric Rating Scale (BPRS) and Clinician-Administered Dissociative States Scale (CADSS) were employed to measure symptoms. Fisher's exact test compared groups regarding SAEs. ANOVAs analyzed symptom data with repeated measures from baseline to 24 h post-infusion.
Results: Forty-one patients (29 UPs, 12 BPs) and 50 controls were treated from September 2011 to September 2013. One UP experienced profound sedation with a Riker score of 2, she recovered fully within 2 h. Another UP suffered cocaine relapse 22 days post-infusion. One BP had severe vomiting. Four subjects (two UP, one BP, and one control) experienced acute psychiatric reactions ("K-holes") with varying degrees of anxiety, fear, violent ideation, dissociation, and aphasia—one UP failed to return to pre-infusion symptom intensity at 190 min post-infusion. Patients reported more anxiety than controls at baseline, it decreased following infusion. Dissociation, substantial in all groups, was greater in BPs vs. UPs vs. controls. On measures of agitation, grandiosity, delusions, and disorientation, patients did not differ from controls. Most measures peaked at infusion end or within 40 min. Increases in thought disorder, odd behavior, excitement, hallucinosis, and dissociation were greater in open-label vs. blinded subjects. History of substance abuse, PTSD, or trauma did not correlate with study measures. Baseline data did not predict SAEs.
Discussion: Due to thought disorder and aphasia, some patients were unratable and most were symptomatic.

Conclusion: Most subjects tolerate 0.5 mg/kg ketamine infusion over 40 min, although dissociation, thought disorder, and aphasia are common. Major adverse reactions are more likely (p=0.043) in mood disorder patients, but not predicted by any demographic or clinical measure studied.

Table (Abstract 10).

Subject category	*n* (SAEs)	Anxiety (1–7) Baseline	Anxiety (1–7) 40' post infusion	Thought disorder (1–7) Infusion end increase	Odd behavior (1–7) Infusion end increase	Hallucinosis (1–7) Infusion end increase	Excitement (1–7) Infusion end increase	CADSS (0–92) Baseline	CADSS (0–92) Infusion end
Unblinded Controls	20 [1]	1.4 (1–2)	2.1$^{\#}$ (1–3)	1.9§ (1–3)	1.8§ (1–3)	1.6§ (1–3)	2.4§ (2–4)	7.4 (4–12)	27.5$^{\S,\#}$ (20–32)
Blinded Controls	30 [0]	1.1 (1–1)	2.0$^{\#}$ (1–3)	1.3 (0–2)	0.8 (0–2)	0.9 (0–2)	1.8 (1–3)	6.7 (3–11)	19.9$^{\#}$ (13–26)
Unblinded UPs	16 [2]	5.2* (4–6)	2.1$^{\#}$ (1–3)	1.8§ (1–3)	1.6§ (1–2)	1.3§ (1–2)	2.3§ (1–4)	9.1 (4–13)	45.4$^{\S,\#}$ (36–51)
Blinded UPs	13 [2]	5.0* (4–6)	2.2$^{\#}$ (1–3)	1.1 (0–2)	0.6 (0–1)	0.8 (0–2)	1.6 (1–2)	8.8 (4–13)	35.2$^{\#}$ (30–42)
Blinded BPs	12 [2]	5.0* (4–6)	2.4$^{\#}$ (1–4)	1.3 (0–2)	1.1 (0–2)	0.8 (0–2)	1.8 (1–3)	18.0* (7–26)	62.6$^{*,\#}$ (44–71)

The number of subjects with serious adverse events [SAEs] is listed in raw numbers in brackets under the total number of subjects in each group, while all other entries represent means (and 25/75 % interquartile ranges) for each subject group for the given measure, whose whole number Likert-based intensity ranges are listed in each column header.

* p<0.05, significant differences based upon psychiatric illness category

$^{\#}$ p<0.05, significant differences across time points

§ p<0.05, significant differences on the basis of blinding status as compared to subjects in same illness category

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* p<0.05, significant differences based upon psychiatric illness category

$^{\#}$ p<0.05, significant differences across time points

§ p<0.05, significant differences on the basis of blinding status as compared to subjects in same illness category

11. Survival of Swine with Nifedipine Toxicity Treated with Methylene Blue

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Background: Calcium channel antagonist-induced shock remains a significant treatment challenge. Nifedipine, a dihydropyridine calcium channel antagonist, has a proposed mechanism of vasodilatation through increased nitric oxide (NO) production. Methylene blue (MB) inhibits NO production by inhibiting the activity of soluble guanylyl cyclase, thus may be useful to reverse hypotension associated with nifedipine toxicity. Methylene blue has not been studied as an antidote for nifedipine toxicity.
Hypothesis: Methylene blue will improve survival following nifedipine intoxication in a swine model.
Methods: This Institutional Animal Care and Use Committee-approved study used 24 swine that were sedated with alpha-chloralose, mechanically ventilated, and instrumented for drug delivery and hemodynamic measures. After stabilization and basal measures, nifedipine (0.01875 mg/kg/min) was infused until toxicity, defined as a reduction in product of cardiac output and mean arterial pressure of 20 %, was reached. Animals received a bolus of 20 mL/kg 0.9 % normal saline once toxicity occurred immediately followed by equal volume amounts of either normal saline as a sham treatment, MB (1 mg/kg as a bolus and subsequent infusion), epinephrine (0.1 μg/kg/min), or MB and epinephrine. All treatments were continued for 5 h after the initiation of toxicity or until death occurred. Hemodynamics was monitored throughout the study. Surviving animals were euthanized. Survival data was analyzed using the Student's *t* test.
Results: Nifedipine toxicity was characterized by vasodilatory hypotension, impaired contractility, and tachycardia with terminal bradycardia. The mean time to death after reaching toxicity was 232±67.5 min. There was no statistically significant change in survival in animals treated with MB, epinephrine, or MB plus epinephrine (Table).
Discussion: We observed no survival treatment effect with MB even in combination with epinephrine. Potential limitations of this experiment include: excessive severity of toxicity, insufficient dose of MB, untreated direct cardiac stress from prolonged compensatory tachycardia, and NO/soluble guanylyl cyclase may play a minor role in nifedipine-induced hypotension.
Conclusion: Methylene blue demonstrated no improvement in survival of swine with nifedipine-induced toxicity. Further studies are needed to elucidate the value of MB in treating calcium channel antagonist-induced shock.

Table (Abstract 11). Mean survival time for each treatment group

Treatment groups	Mean survival time±SD (min)	Statistical significance of treatment group compared to control*
Saline (control)	232±67.5	
Methylene blue	211±90.7	p=0.62
Epinephrine	234±115	p=0.99
Epinephrine and methylene blue	229±96.4	p=0.94

*Calculated using unpaired, two-way Student's *t* test.

12. Incidence and Outcomes of Adult Cardiac Arrest Associated with Toxic Exposure Treated with Therapeutic Hypothermia (ToxiCool)

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Background: Therapeutic hypothermia improves neurologic recovery in cardiac arrest patients who regain spontaneous circulation. The incidence and outcome of patients who undergo therapeutic hypothermia after cardiac arrest associated with a toxic exposure is unknown.
Research question: This study describe the incidence, epidemiologic characteristics, and outcomes of patients who suffer cardiac arrest associated with toxic exposure that are treated with therapeutic hypothermia.
Methods: This is a retrospective review of a postcardiac arrest database and medical records of all patients registered to receive therapeutic hypothermia via our institution's clinical pathway between November 2007 and February 2013. The database includes prospectively collected clinical data utilizing Utstein criteria and the Cerebral Performance Categories (CPC) Scale. All patients were treated in an evidence-based clinical pathway that included therapeutic cooling. The database and each patient's medical record was systematically reviewed independently by two physician investigators to determine a toxic versus nontoxic cardiac arrest with toxic defined as a xenobiotic that directly and immediately caused the patient's cardiac arrest. Causality was determined by consensus of two of three investigators. Groups were compared using Fisher's exact test.
Results: Three hundred eighty-nine patients underwent treatment during the study period and 48 of 389 (12 %) were deemed toxic arrests. Patients who suffered toxic arrests were slightly younger, less likely to have an initial shockable rhythm, and less likely to receive bystander CPR as compared to nontoxic cases (see table). The most common xenobiotics included cocaine (n=16), benzodiazepines (n=13), and opioids (n=9). Within the toxic subset, an initial shockable rhythm was associated with greater survival rate (11/16) than a nonshockable rhythm (9/31; p=0.01).
Discussion: Toxic patients treated with therapeutic hypothermia had similar survival and neurologic function compared to nontoxic causes. Limitations to our study include accuracy of assigning causality, incomplete confirmation of exposures, relatively small patient population, CPC scores extrapolated from medical records, and inability to control for potentially confounding co-morbid conditions.
Conclusion: Toxin-associated cardiac arrests accounted for a significant proportion of patients in this study. Additional, larger studies may help to elucidate the optimal role for therapeutic hypothermia in toxin-induced cardiac arrest.

Table (Abstract 12). Subject data

	Toxic arrests (n=48)	Nontoxic arrests (n=341)	p value
Mean age±SD (years)	47±13.6	59±19.1	0.0001
Age range (years)	18–77	19–94	
Male	29 (60 %)	217 (64 %)	0.75
Out of hospital arrest	43 (90 %)	328 (96 %)	1.00
Initial shockable rhythm	16 (33 %)	215 (63 %)	0.0001
Survival	20 (42 %)	152 (45 %)	0.76
High-functioning survivors	17 (35 %)	139 (41 %)	0.53
Bystander CPR	21 (44 %)	212 (62 %)	0.03

13. The Use of Physostigmine by Toxicologists in Anticholinergic Toxicity

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Background: The anticholinergic toxidrome is well described and relatively common, seen over 350 times by toxicologists reporting to the ACMT Toxicology Investigators Consortium (ToxIC) registry in 2012. Administration of physostigmine is generally regarded as the antidote to anticholinergic toxicity. While physicians without toxicology training may be reticent to use physostigmine due to their unfamiliarity, we would expect that trained toxicologists would be relatively liberal in its use.
Research question: How often is physostigmine administered to patients with anticholinergic toxicity that are evaluated by a toxicologist?
Methods: We retrospectively analyzed data in the ToxIC registry, representing data from medical toxicologists in multiple institutions nationwide, searching for patients who exhibited an anticholinergic toxidrome, determining what treatment(s) they received, and classifying the treatments as physostigmine, benzodiazepines, physostigmine and benzodiazepines, antipsychotics, or no definitive treatment.
Results: Three hundred fifty-two patients were seen by toxicologists for anticholinergic toxidromes in 2012, of which 113 (32.1 %) were given benzodiazepines alone, 46 (13.1 %) were given physostigmine alone, 32 (9.1 %) received both physostigmine and benzodiazepines, 12 (3.4 %) were given antipsychotics, and 149 (42.3 %) were given no definitive treatment. Of the patients who received physostigmine alone or in combination, five (6.4 %) required intubation and one (1.3 %) developed rhabdomyolysis. Of those who received benzodiazepines alone or in combination, 17 (11.7 %) required intubation and 4 (2.8 %) developed rhabdomyolysis. Of those who did not receive physostigmine, 25 (9.1 %) required intubation and 8 (2.9 %) developed rhabdomyolysis. Those who received physostigmine had a lower rate of intubation (6.4 vs 9.1 %) and rhabdomyolysis (1.3 vs 2.9 %) than those who did not, but the differences were not significant (OR, 0.68; 95 % CI, 0.25–1.84 (p=0.45) and OR, 0.56 95 % CI, 0.07–4.53 (p=0.59), respectively).
Discussion: These data suggest that patients with anticholinergic toxicity are more likely to receive benzodiazepines than physostigmine (32.1 vs 13.1 %) as monotherapy, and a significant number of these patients did not receive treatment for their toxidrome. The use of physostigmine was not correlated with intubation rates or rhabdomyolysis though numbers were small.
Conclusion: We find it interesting that physostigmine was infrequently used as treatment by toxicologists, given its recommendation for use in anticholinergic toxicity.

14. Effects of Calcium Channel Blocker Poisoning Interventions: A Systematic Review

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Context: No summary of evidence has been published for calcium channel blocker (CCB) overdose.
Objective: This review sought to evaluate effects of proposed treatments on mortality, morbidity, hemodynamics, functional status, hospital length of stay (LOS), intensive care (ICU) LOS, duration of vasopressors use, and serum levels of CCB in poisoned adults.
Methods: We performed a search of both commonly used databases and gray literature to identify studies examining treatment effects on targeted

outcomes. Two reviewers independently selected studies and a group of reviewers abstracted all relevant data using a pilot-tested form. A second group analyzed risk of bias and overall quality with standardized tools. Qualitative synthesis was used to summarize evidence.
Results: Of the references, 15,621 were identified by our search strategy, and 81 articles and 103 case reports were included. The only observational studies were for high-dose insulin (HDI) and extracorporeal life support (ECLS). Only case series and animal studies were found for atropine, vasopressors, calcium, glucagon, lipid emulsion, 4-aminopyridine, and levosimendan. Decontamination, pacemaker, and plasma exchange were studied in the case series. Risk of bias across studies was high for all interventions and moderate to high for ECLS. HDI was beneficial to hemodynamics and lessened mortality at the risks of hypoglycemia and hypokalemia (low quality of evidence (QOE)). ECLS showed potential to improve survival in severe shock and cardiac arrest patients at costs of limb ischemia, thrombosis, and bleeding (low QOE). Calcium, dopamine, or norepinephrine, could improve hemodynamic parameters and survival without severe side effects (very low QOE).
Conclusion: HDI and ECLS were the most strongly supported interventions in the literature. However, evidence on CCB poisoning treatment is of low quality and is drawn from a heavily biased heterogenous literature.

Original Research: Poster Presentations

15. Overdoses and Organ Donation: Barriers to Salvaging Good from Tragedy

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Background: Several drugs known to mimic brain death in overdose have led to confused prognoses and unintended harm. We present three cases of fatal opioid poisoning that would have delayed pronouncement of death via standard means undermining organ donation but for the addition of a cerebral perfusion study (CPS).
Hypothesis: Relying on prerequisite findings in brain death (coma, absent brainstem reflexes, and apnea) have limited predictive value and the potential for catastrophic harm (premature organ donation) in drug overdose while pending drug concentrations cause harm by delay, in these cases CPS can ultimately hasten diagnosis.
Methods: A review of consult service records was performed and all patients on whom a CPS was performed in order to facilitate determination of brain death were included.
Results: Three patients with accidental opioid exposure, an 8-month-old boy, a 16-year-old girl and a 28-year-old male heroin addict, were found comatose and with respiratory failure. Two had arrested prior to hospitalization. All had severe anoxic injury and deteriorated over 24–48 h becoming increasingly difficult to support. Formal brain-death exams in each demonstrated absent electrical activity on electroencephalogram, lack of response to ventilatory drive (PCO_2, hypoxia) and absent brain stem reflexes; however, families were hesitant to allow organ procurement until they were reassured drug intoxication was not blunting response during the death exam. In each patient, a CPS demonstrated a lack of perfusion ultimately facilitating brain death diagnosis and organ donation.
Discussion: The medical literature includes reports where various types of drug overdose mimicked brain death. State criteria for determining brain death typically include a formal neurologic exam, lack of patient response to ventilatory drive off sedation (i.e., 15 mmHg increases in PCO_2) and optional EEG. Additionally, in overdoses, it is suggested brain death not be diagnosed until toxic drug concentrations are absent. Determining drug concentrations however often take significant time potentially undermining continued stability compromising procurement of viable organs for transplantation in applicable cases.
Conclusion: Cerebral perfusion study may provide us with a more efficient way to ascertain patient death in overdose victims when drug toxicity mimics brain death.

16. Use of Multidose Activated Charcoal in the ToxIC Registry

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Background: A position paper from AACT and EAPCCT in 1999 provides an evidence-based review of the literature and guidelines on the use of multidose-activated charcoal (MDAC) for acute poisonings. The ACMT Toxicology Investigators Consortium (ToxIC) registry is a robust data source that offers important epidemiological insight poisoning trends and practices.
Hypothesis: Do current MDAC treatment practices by toxicologists involved in the Toxicologic Investigators Consortium align with published guidelines?
Methods: We reviewed the ToxIC Case Registry in its entirety (2010–present) for cases involving MDAC treatment. Descriptive statistics were used for analysis.
Results: Out of nearly 25,000 case entries, the Registry contained 66 patients treated with MDAC for an acute poisoning. Two (3 %) were between 7 and 12 years old, 20 (30 %) were between 13 and 18 years old, 41 (62 %) were 19–65 years old, and 3 (5 %) were older than 65. Forty-four (66 %) were women, and one was pregnant. Salicylates were involved in 29 of 66 cases (44 %), 18 (27 %) of which they were the sole toxin. Valproic acid was second most common in 12 cases (18 %; five polydrug). Eight (12 %) were phenytoin ingestions (one polydrug). Seven (11 %) involved acetaminophen (six polydrug). Four (6 %) involved carbamazepine, three (5 %) involved theophylline, two (3 %) involved cyclobenzaprine (one polydrug), two (3 %) involved amitriptyline (one polydrug), two involved ibuprofen (one polydrug), three involved phenobarbital (three polydrug), and several drugs/toxins were involved in a single poisoning: lamotrigine, cyclopeptide-containing mushrooms, colchicine, XR diltiazem, propoxyphene, atenolol, and quetiapine. Secondary agents involved in more than one of the ingestions included diphenhydramine (three), caffeine (three), and benzodiazepines (three).
Discussion: Previously published practice guidelines suggest MDAC should be considered in life-threatening poisonings involving carbamezapine, dapsone, phenobarbital, quinine, or theophylline. While some of these ingestions are not common, carbamezapine, phenobarbital, and theophylline were among the ingestions treated with MDAC in the ToxIC Registry. The most common drug ingestion, however, in which MDAC was used in the Registry were salicylates despite consensus guideline specifically not recommending MDAC be used for salicylates (although this recommendation remains controversial).
Conclusions: MDAC is infrequently used to facilitate drug elimination in ToxIC cases and practice contrasts somewhat from published guidelines. An update on MDAC use is warranted.

17. Fluoroamphetamine (4-FA)-Induced Cardiogenic Shock Confirmed with Serum and Urine Levels

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Background: 4-Fluoroamphetamine (4-FA) is a parasubstituted phenethylamine-type synthetic stimulant with numerous internet blog postings, but no clinical case reports in the medical literature.
Purpose: We report a case of a young man who developed severe toxicity after using 4FA with laboratory confirmation.

Methods: An 18-year-old male presented to the ED with vomiting and chest tightness. He was alert, oriented, diaphoretic, with respiratory rate 16, heart rate=103, blood pressure=130/52, SpO_2=100 % on R.A, *T*= 97.7, and an otherwise unremarkable exam. Two days prior, he received naltrexone IM as part of an opioid addiction treatment and was taking fluoxetine and trazodone. He used a new drug of abuse about 5 h before presentation. Initial laboratory studies were significant for WBC (38.5), HgB (17.8), and urine drug screen positive for amphetamine, THC, and opiates. Initial ECG showed sinus tachycardia with upward sloping ST depression in inferior leads and no ST segment elevation. After few hours, he became extremely diaphoretic and hypoxic. He was intubated and sedated then had a brief PEA arrest. CXR showed pulmonary edema and his cardiac echo showed LV hypokinesia, sparing the apex, with EF= 10 %, troponin=8.3 ng/ml. He became hypotensive and was treated with dobutamine and epinephrine infusions and placed on an intraaortic balloon pump. Cardiac function improved within 48 h and repeat echo showed EF=35 %. Comprehensive toxicology testing revealed fluoroamphetamine, naproxen, fluoxetine, trazodone, naltrexone, nicotine and cotinine in urine, and fluoroamphetamine, naproxen, trazodone, and cotinine in serum. The 4FA urine level was 64,000 ng/ml and serum level was 118 ng/ml.
Discussion: Our patient experienced severe toxicity after taking 4-FA, which included cardiogenic shock requiring invasive management and life support. With no previously reported 4-FA clinical poisoning cases to compare with and relying on its comparative pharmacology to other stimulant drugs, we suspect the toxic mechanism was an acute cardiomyopathy due to a catecholamine-induced myocarditis and/or small vessel myocardial ischemia. Cardiogenic shock due to acute cardiomyopathy has been reported with methamphetamine abuse.
Conclusion: Recreational use of 4-FA may present with life-threatening cardiac toxicity including cardiomyopathy and cardiogenic shock and pulmonary edema.

18. An Algorithm for the Recognition and Treatment of Fire-Related Cyanide Exposure

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Background: The clinical indications for the treatment of hydrogen cyanide toxicity in the critically ill patient have been described. However, minimally symptomatic patients often present to emergency departments in high numbers after potential cyanide exposure in the setting of house fires. Evidence-based guidelines are needed to support rapid treatment of fire victims (or emergency responders) with a critical cyanide exposure, while limiting unnecessary testing or therapy in patients without evidence of toxicity.
Hypothesis: A single algorithm can be developed for the evaluation and treatment of cyanide toxicity in patients with smoke inhalation.
Methods: In September 2013, we performed a systematic review of the English and German literature indexed in PubMed. Abstracts that appeared applicable to the diagnosis, management, and complications of inhalational cyanide toxicity were systematically screened. We included animal studies, case reports, systematic reviews, expert panel recommendations, consensus statements, and prospective studies. No human-randomized controlled trials were found. Studies older than 25 years or those not available in electronic format were excluded. In addition, a nonsystematic literature search was performed to answer specific questions such as long-term outcomes of cyanide toxicity and laboratory interference of antidotes. We inspected the reference lists of all relevant articles.
Results: Our search found 1,484 reports, of which 207 abstracts and 95 studies were analyzed. We found that inhalational cyanide toxicity associated with CNS and respiratory depression, acidemia, seizure, hypotension, cardiac ischemia, or cardiac arrest required empiric treatment. Altered mental status, vomiting, hyperpnea, tachypnea, and bradypnea should prompt a search for cyanide toxicity (using serum lactate >8 mmol/L as a marker) and carbon monoxide exposure. The presence of other, mild symptoms (e.g., headache, nausea, dizziness, and weakness) without vital sign abnormalities is unlikely to indicate clinically significant cyanide toxicity, and should not result in antidotal therapy, or specific laboratory evaluation; however, carbon monoxide toxicity should be considered in these patients.
Conclusions: We propose a diagnostic algorithm that delineates evaluation and treatment indications for patients who range from minimally symptomatic to critically ill after potential cyanide exposure via smoke inhalation.

19. Neurotoxicity from Sidewinder Rattlesnake Envenomation in Arizona

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Background: North American rattlesnake envenomations typically result in local tissue injury and hematotoxicity. Neurotoxicity is uncommon and most often associated with bites by the Mojave rattlesnake, *Crotalus scutulatus*. Neurotoxicity following bites by the Sidewinder rattlesnake, *Crotalus cerastes*, has not been reported.
Hypothesis: This is the first reported case of a Sidewinder envenomation resulting in neurotoxicity.
Methods: This is a case report of a 56-year-old man who was bitten on the right foot through a leather boot by a snake he described as having horns and exhibiting sideways movement. Two independent herpetologists confirmed the species to be *C. cerastes* by photo. The patient developed painful right-sided paresthesias and weakness progressing from the toes to the distal thigh. Physical exam 3 h after the bite revealed ecchymosis at the bite site, decreased sensation in the right foot, mild weakness of the leg, and pronounced fasciculations of the anterior thigh musculature. Fasciculations progressed to involuntary contractions of the large muscles of the thigh. Laboratory studies revealed normal platelets, protime, fibrinogen, CPK, and electrolytes throughout hospitalization. Antivenom was withheld based on unclear benefit for treatment of neurotoxicity. Over the next 48–72 h, symptoms progressed to include right arm, bilateral ptosis, and respiratory muscle weakness with three consecutive worsening negative inspiratory force measurements. Respiratory failure did not occur. He was anorexic and unable to walk independently. On day 5, he had improved enough to ambulate with a walker and was discharged. On 10-day follow-up, he reported continued but improved paresthesias, right-sided weakness, atypical chest pain, poor appetite, and new abdominal cramping. The patient was lost to follow up.
Results: The patient developed prolonged neurotoxicity without hematotoxicity or significant local tissue injury.
Discussion: *C. cerastes* has not previously been implicated in the development of neurotoxic venom effects.
Conclusion: Neurotoxicity may develop following bites by the Sidewinder rattlesnake. It is unknown whether such effects would be prevented or reversed with antivenom.

20. Clinical Presentations with Different Glyphosate-Containing Herbicides

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Background: Glyphosate is a commonly used herbicide associated with toxicity and death following large ingestions. Surfactants are implicated as the primary contributor.
Hypothesis: Glyphosate herbicide preparations contain various surfactants and salts which may lead to diverse clinical toxicity.

Methods: (Case 1) A 50-year-old man presented with N/V, abdominal pain, and somnolence 12 h after ingesting 6.5 oz of concentrated Round-up® containing 50.2 % glyphosate as isopropylamine salt. Labs revealed metabolic acidosis (AG 40), lactate (9.2 mmol/L), creatinine (2.8 mg/dL), potassium (4.5 mmol/L), WBC (41.5 K/mm^3), and lipase (2,528 IU/L). Electrocardiogram QRS was 142 ms and responsive to bicarbonate. Patient became hypoxic and hypotensive requiring intubation, vasopressors, and continuous veno-venous hemodialysis (CVVHD) for anuric renal failure. A CT scan showed multiple loops of dilated small bowel and possible pneumatosis with negative exploratory surgery on day 1. On day 5, he had peritonitis prompting the resection of the ischemic terminal ileum and cecum. Over the next 3 weeks, he developed recurrent GI bleeds unrelated to surgery, remained anuric on CVVHD, and ventilator dependent. (Case 2) A 48-year-old landscaper ingested 250–350 mL of concentrated glyphosate herbicide and presented with AMS and N/V. Labs showed WBC (21.2 K/mm^3), potassium (7.1 mmol/L), metabolic acidosis (AG 10), and creatinine of 1.2 mg/dL (0.60 baseline). Electrocardiogram QRS was 192 ms with wide complex rhythm, bradycardia, and responsive to bicarbonate. Persistent hyperkalemia continued despite medical treatment requiring high flux hemodialysis. He required ventilator support for hypoxia and had a negative EGD.
Results: Case 1 developed anuric renal failure, QRS prolongation, ischemic bowel, and recurrent GI bleeds. Care was withdrawn on day 25. Case 2 had persistent hyperkalemia, non-anuric renal failure, QRS prolongation, and bradycardia.
Discussion: We hypothesize that case 2 ingested a potassium salt preparation due to the persistent hyperkalemia that only resolved with hemodialysis. QRS prolongation was present in both cases responsive to bicarbonate.
Conclusion: Glyphosate containing herbicides may have diverse clinical toxicity depending on surfactant and salt preparation.

21. Hemodialysis for Salicylate Toxicity During Therapeutic Hypothermia

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Background: Hemodialysis is a well-established method of rewarming after hypothermia. Less is known about the effect of hemodialysis on temperature in the setting of hypothermia after cardiac arrest (HACA).
Hypothesis: When indicated for the treatment of overdose, hemodialysis can be performed during HACA without adverse event.
Methods: This is a single-patient chart review. A 57-year-old woman presented to a level 1 trauma center with a self-inflicted stab wound to her left chest. Imaging revealed a pneumothorax, which was treated with tube thoracostomy. Ten hours later, the patient became unresponsive. Arterial blood gas showed a pH of 7.4, $PaCO_2$ of 35, and PaO2 of 88 mmHg. The patient was intubated, and 10 min later became systolic. She was treated with chest compressions, epinephrine, and sodium bicarbonate, leading to ventricular tachycardia. Return of spontaneous circulation was achieved with defibrillation. Post arrest, venous blood gas revealed a pH of 7.18 and $PaCO_2$ of 73 mmHg. Labs sent at the time of the arrest were significant for a serum aspirin level of 100 mg/dL. Hemodialysis was indicated for treatment of the salicylate overdose; however, concerns arose regarding dialysis catheter placement and temperature maintenance during active cooling. After discussions with toxicology, hemodialysis was initiated. The patient improved and was discharged to inpatient psychiatry on hospital day 46.
Results: The patient was actively cooled to goal temperature within 3 h of initiating the hypothermic protocol despite placement of the dialysis catheter and preparing to start hemodialysis.
Discussion: Although our results are based on a single patient, hemodialysis for treatment of salicylate toxicity does not appear to impair active cooling. We do not believe that hemodialysis or HACA should delay or contraindicate each other in the rare cases where both are required. More data needs to be collected to determine the relationship between cooling times and hemodialysis parameters.
Conclusion: Hemodialysis for the treatment of salicylate toxicity does not interfere with HACA.
Table (Abstract 21). Temperature and aspirin concentration over time

Time	9:23	11:00	13:00	15:00*	16:30	20:00
ASA (mg/dL)	100		101		108	21
Temp (C)		40.7	35.4	32.4	34.2	34.9

*Hemodialysis started

22. A Retrospective Analysis of Antiretroviral Agents and Outcomes from a Regional Poison Center

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Background: Antiretroviral (ARV) agents used in the treatment of human immunodeficiency virus (HIV) have a well-described toxicity described in chronic use. However, the frequency of toxicity from overdose has not been investigated.
Hypothesis: The objective of this study was to quantify the number of reported cases of toxicity from ARV to a regional poison center and to determine if any patients developed clinical manifestations of toxicity.
Methods: We conducted a retrospective review of poison center records between January 1, 2000 and December 31, 2012. All single formula and combination formula products were searched. We screened all cases for number of exposures and clinical outcome
Results: Our poison center received 17 calls with 8 confirmed exposures to ARV. We had six intentional exposures and two unintentional exposures. No patients with either intentional or unintentional exposures developed toxicity. One patient with intentional exposure developed dehydration from diarrhea and required intravenous fluids in a health care facility.
Discussion: There are 56,000 new cases of HIV reported each year. In 2010, the Centers for Disease Control and Prevention stated that there were more than 1.1 million people living with HIV in the USA. Our poison center covers four states and according to each state's department of health statistics, serves an HIV population of 23,037. Our analysis shows that ARV exposures were infrequently reported to our regional poison center. Of the cases that were reported, toxicity from intentional exposure was not found. In order to determine whether toxicity from intentional exposures do occur, a national investigation of poison center data should be undertaken.
Conclusions: ARV drug toxicity from intentional exposure reported to our poison center does not seem to cause toxicity.

23. Fomepizole Clearance with Continuous Renal Replacement Therapy

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Background: When patients become hemodynamically unstable from the acidosis of toxic alcohol metabolites, many nephrologists

will prefer to place patients on continuous renal replacement therapy (CRRT). While fomepizole dosing has been studied in patients undergoing hemodialysis, there have not been any studies that have measured fomepizole clearance in patients undergoing CRRT. In this case report, we measured fomepizole clearance from a single patient who was treated with intravenous fomepizole and underwent CCRT.

Case report: A 63-year-old male presented to a tertiary metropolitan emergency department with severe intoxication and acidosis. Initial laboratory findings included pH-7.18, pCO_2-14 mmHg, pO_2-125 mmHg, bicarbonate-4 mEq/L, anion gap-39 mEq/L, BUN-31 mg/dL, and creatinine-3.0 mg/dL. These findings were essentially unchanged following administration of 2 l normal saline and 100 mEq sodium bicarbonate. Because toxic alcohol ingestion was suspected, 15 mg/kg IV fomepizole was administered. The patient was placed on CRRT, and fomepizole concentrations were measured prior to beginning CRRT and every 4 h thereafter. When the ethylene glycol and methanol concentrations returned below limits of detection 6 h later, no additional fomepizole dosing was administered.

Results: The average clearance of fomepizole during CRRT in this case was 12 μmol/L/h. The R^2 value for clearance was 0.993.

Discussion: In our patient undergoing CRRT, clearance of fomepizole was 12 μmol/L/h, which is double the healthy volunteer rate of 6 μmol/L/h. Despite the apparent increase in fomepizole clearance, all concentrations obtained for 16 h after the initial dose of fomepizole during CRRT were above the assumed therapeutic concentration in humans.

Conclusion: While this case report suggests that fomepizole dosing does not need to be adjusted during CRRT, a formal clinical trial would need to determine the best dosing of fomepizole during CRRT.

24. Respiratory Failure, QTc Prolongation, and Myoclonic Movements after Massive Pediatric Ondansetron Oral Dissolving Tablet Ingestion

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Background: Ondansetron, a centrally acting 5-HT3 receptor antagonist when used for preventing emesis, has a well-established safety profile. Large, pediatric symptomatic ingestions have not been well described.

Hypothesis: Ondansetron-mediated 5-HT3 antagonism may cause severe toxicity in massive overdose.

Methods: This is a case report. The hospital consulted the regional poison center. Clinical course and laboratory data were obtained as a result of this consultation.

Results: A previously healthy 2-year-old female presented after suspected consumption of 58 (36 mg/kg) ondansetron 8 mg oral dissolving tablets (ODT) out a bottle of 60. Only two tablets were found. Within 1 h of ingestion, the child demonstrated difficulty ambulating, nystagmus, tremors, and sleepiness. At the initial healthcare facility, the patient had emesis and worsening CNS depression, requiring intubation and mechanical ventilation. Heart rate was 152 and blood pressure was 138/87 (lowest at 80/38). EKG showed sinus tachycardia with QTC prolongation of 507 ms. Exam was significant for myoclonic jerks with unequal but reactive pupils. Laboratory evaluation and head CT scan were normal. On the following day, the patient became more responsive, and the QTC prolongation resolved with her recovering without sequelae.

Discussion: By history, this patient ingested a massive overdose. Ondansetron has a well-described safety profile with a large therapeutic margin. In the USA, ondansetron ODT is typically dispensed in blister packs. Because of hyperemesis gravidarum, the child's mother obtained a bottle of 60 ondansetron ODT without blister pack packaging from a foreign pharmacy. The ODT formulation has a flavoring agent in the tablet making them palatable to children. The mechanism of toxicity is uncertain but has been attributed to increase of synaptic serotonin concentrations as a result of 5-HT3 receptor antagonism and decreased receptor selectivity. Ondansetron may also be a weak antagonist of 5-HT1A, 5-HT1B, and α1-adrenergic receptors.

Conclusion: Because of flavoring and rapid oral dissolution, ondansetron ODT can be attractive to children and result in severe consequences. Appropriate packaging such as blister packs may deter children from significant ingestion. In our patient, toxicity manifested as CNS depression requiring intubation, QTc prolongation, hypotension, and symptoms of serotonin excess.

25. Medical Toxicology Education in Medical Schools in the USA

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Background: Exposure to medical toxicology (MT) early in training may be important to educate medical students in caring for poisoned patients and may encourage interest in the specialty. The availability of MT education in US medical schools has not previously been described.

Research question: The purpose of this study is to describe the prevalence of MT rotations, MT faculty, and poison center (PC) access in US medical schools.

Methods: A listing of allopathic US medical schools was obtained from the American Association of Medical Colleges (AAMC) website. Each school was evaluated for the presence of a MT student clerkship by searching the AAMC Visiting Student Application Service, medical school clerkship websites, and personal communications with MT faculty. Medical toxicologists' affiliations were identified through the ACMT database, MT fellowship websites, and the AAMC online faculty database. Lastly, medical school-affiliated PCs were identified using the American Association of Poison Control Center's (AAPCC) website.

Results: MT clerkships are available at 47/141 (33 %) of US medical schools. Eighty-nine of 141 (63 %) have MT faculty, 34/141 (24 %) of these have three or more medical toxicologists. Of schools with MT faculty, 45/89 (51 %) have MT clerkships. Forty-eight of 141 (34 %) medical schools are affiliated with PCs (the remaining 8 PCs do not have medical school affiliations). Thirty-one of 48 (65 %) of schools with PC affiliations have MT clerkships. Thirty-two of 141(23 %) have MT fellowships, 29/32 (91 %) of fellowships have an associated MT clerkship.

Discussion: Identifying medical schools without formal MT education and/or faculty will help target future MT educational efforts. The goal is to improve clinical understanding of poisoning and awareness of the specialty at the medical student level. Finding ways to improve medical student education and assessing the impact is an important next step.

Conclusion: While nearly 2/3 of US allopathic medical schools have MT faculty, only 1/3 have MT clerkships.

26. Mortal Questions: The Prevalence of Care Withdrawal after Intentional Self-Poisoning

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Background: Suicidal patients often refuse life-saving care, but emergency physicians still intervene under the pretense that capacity to refuse care is lost in actively suicidal patients. Treatment may, however, be withdrawn later as futility of treatment become apparent. Although withdrawal of care after suicide (WOCAS) requires significant ethical considerations, no studies report the prevalence of this phenomenon.
Objective: This study aims to identify the prevalence of WOCAS among regional poison control center cases.
Methods: This is a cross-sectional survey of all adult deaths reported to a regional poison control center (PCC) between January 1, 2003 and June 30, 2013. Records were retrieved retrospectively from Toxicall. Three unblinded data abstractors recorded cases and inter-rater reliability (kappa) was calculated. Age, gender, suspected suicide (SS), and documented withdrawal of care (WOC) were abstracted. The categorization of SS was based on the suspicion of the healthcare provider requesting consultation with PCC, and was recorded as yes, no, or unknown. Only cases with a documented decision to discontinue life-saving therapies or refrain from escalation in care were considered WOC.
Results: Two hundred fifty-nine cases met inclusion criteria. There were 70 cases (27 %) of WOC which represented 27.5 % of all suicide deaths and 23.4 % of all nonsuicide deaths (p=0.16). The average age of suicide deaths was 45 (interquartile range (IQR), 37–58) versus 50 (IQR, 34–66) (NS) in nonsuicide deaths. The average age of patients with WOCAS was 53 (IQR, 37–58) versus 67 (IQR, 59–84) for WOC in nonsuicide patients (p<0.05). Kappa was >0.7.
Discussion: This study documents prevalence of WOCAS among PCC deaths. The primary limitation in this study is the use of PCC charts, which may have underestimated the amount of suspected suicides and/or WOC cases due to under documentation. This is supported by prior studies documenting WOC rates in ICU patients ranging from 50 to 90 %. A prospective case–control study incorporating additional information, such as a comorbidity index, severity of illness, and time from presentation to WOC would improve our understanding of this problem.
Conclusion: The prevalence of withdrawal of care after suicide suggests that prospective studies are needed to highlight the major influences on this mortal question.

Table (Abstract 26). Patient demographics

	All cases				Withdrawal of care			
	Total	Age (IQR)	Female	Male	Total	Age (IQR)	Female	Male
All deaths	259	47 (36–57)	130	129	70	54 (44–62)	41	29
Suicide deaths	138	45 (37–58)	75	63	38	53 (37–58)	26	12
Non-suicide Deaths	47	50 (34–66)	18	29	11	67 (59–84)	3	8
Suicidality unknown	74	44 (35–52)	37	37	21	47 (43–53)	12	9

27. Portable Biosensors to Detect Physiologic Changes in Opioid Use: A Pilot Study

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Background: Portable biosensors have been used to monitor physiologic variables in natural environments and have been shown to be useful in the monitoring of cocaine addiction by identifying craving and relapse. Similarly, biosensor technology could provide critical information in opioid addiction and treatment. However, there are no data on the changes measured by biosensors after opioid exposure.
Research question: Do biosensor-monitored parameters change after therapeutic opioid administration?
Methods: This is an institutional review board-approved observational study of four emergency department patients receiving parenteral opioids. Exclusion criteria were as follows: age <18 or >90, pregnancy, trauma-related chief complaint, upper extremity amputation, and inability to consent. After enrollment, patients were asked about prior opioid exposure, home medications, and dominant handedness. The patient's electronic medical record was also evaluated for history of opioid prescriptions or use. A portable biosensor (Q sensor, Affectiva) was placed on the inner wrist of each subject, which continuously measured electrodermal activity (EDA), skin temperature, and locomotion. Data were continuously recorded for 5 min prior to opioid administration, during administration, and for 30 min after administration. Data were analyzed for overall trends in biometric parameters following administration.
Results: Individual results are presented in the table.
Discussion: In this pilot study, opioid injection was associated with a rise in EDA. Previous opioid use seemed to be associated with a blunted response. In one patient, apparent drug-seeking behavior correlated with lack of change in EDA. Laterality seemed to be an important factor, as magnitude of response varied between dominant and nondominant wrists. Biometric changes should be further explored as a marker of opioid use in various clinical scenarios. Limitations: Larger application across varying ages, demographics, and range of opioid tolerance will be required to further delineate the expected biometric parameter changes.
Conclusion: Changes in EDA occur with administration of opioids, may vary depending on opioid use history, and can be easily measured by portable biosensors.

Table (Abstract 27). Participant characteristics and responses

Patient	Age	Gender	History of opioid use	Intervention	Response
1	82	M	Opioid naïve	4 mg morphine	650 % rise in EDA
2	47	M	Recent short-term opioid use	1 mg hydromorphone	200 % rise in EDA
3	43	F	Chronic opioid use	1 mg hydromorphone	No change in EDA
4	72	M	Chronic opioid use	4 mg morphine	70 % rise in EDA in nondominant wrist 55 % rise in EDA in dominant

28. Misuse of Pregabalin, Gabapentin and Baclofen in UK Men who Have Sex With Men Clubbers

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Introduction: Pregabalin, gabapentin and baclofen produce central nervous system effects by interaction with gamma-aminobutyric acid (GABA) and/or GABA receptors. There has been interest in internet discussion fora and in recent anecdotal reports to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) of pregabalin misuse. Baclofen is used in the treatment of GHB withdrawal and there are reports of users buying baclofen off the internet to self-treat withdrawal. There is no data on the prevalence of misuse of these drugs. The aim of this survey was to investigate misuse of these drugs in a clubbing cohort that have previously been shown to have a high prevalence of use of recreational drugs.
Methods: We surveyed adults attending nightclubs catering for men who have sex with men (MSM) in South London in June 2013. Basic demographic data (age, sex, whether they had sex with men, women or both), together with data on whether individuals had heard of pregabalin, gabapentin and baclofen and if so, whether they had ever misused them

were collected. Participants were classified MSM if they were male and had sex with men or both men and women.
Results: There were 313 respondents: 282 (90.1 %) male, 30 (9.6 %) female, 1 (0.3 %) transgender, mean±SD age 31.3±7.6 years. Two hundred forty-eight (79.2 %) were MSM. Amongst MSM, 28(11.3 %) had heard of pregabalin, 26 (10.5 %) of gabapentin and 32 (12.9 %) of baclofen. Of these, six (21.4 %) had misused pregabalin, one (3.8 %) gabapentin and eight (25 %) baclofen. Overall, 11 (4.4 %) had misused one or more of these drugs in their lifetime. Seven (63.6 %) obtained these drugs from dealers, four (36.4 %) from friends, four (36.4 %) from a primary-care doctor, three (27.3 %) from the internet and three (27.3 %) from family. Eight (72.7 %) obtained the drugs from multiple sources. Last month, use of recreational drugs was high in the MSM cohort: mephedrone (67.3 %), GHB (50.4 %) and cocaine (43.2 %).
Conclusion: The results suggest that there is misuse of pregabalin, gabapentin and baclofen in a small, but significant proportion of this high drug-using MSM population. Further work is required to determine whether this is more widespread and to further understand the routes of supply and motivations for use so that appropriate preventive strategies can be implemented.

29. Qsymia Induced Bilateral Acute Angle-Closure Glaucoma

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Background: Obesity has reached epidemic proportions with about one third of North American considered to be obese. Qsymia, a combination of phentermine and extended release topiramate, was approved by the FDA in 2012 making it one of the first weight loss medications approved since fenfluramine/phentermine.
Methods: This is a single-patient chart review. A 38-year-old obese woman presented to the emergency department with bilateral blurry vision for 1 day. In addition, she reported bilateral eye pain and flashes of light. She denied headaches, nausea, vomiting, or eye trauma. She had been taking Qsymia for 7 days as a weight loss aid. She had normal vitals and basic labs. Her eye exam demonstrated bilateral conjunctival injection, 4 mm reactive pupils, visual acuity 20/200 OD and 20/100 OS, intact extra-ocular movements, and normal retinas and ocular nerves on fundoscopic exam. She was found to have bilateral acute angle closure glaucoma (BAACG) with intraocular pressures (IOP) of 48 mmHg OU.
Results: The patient was treated with brominodine, metoprolol, mannitol, solumedrol, and homatropine. Her IOP improved to 21 mmHg OS and 22 mmHg OD prior to discharge 24 h later.
Discussion: Our patient experienced BAACG secondary to her use of once-daily Qsymia, which contains 3.75 mg of phentermine and 23 mg of topiramate. While BAACG has been described in relation to topiramate in the ophthalmology literature, to our knowledge, it has not been described for Qysmia or in the toxicology literature. The mechanism of the development of BAACG from topiramate is hypothesized to be a uveal effusion leading to anterior displacement of the lens-iris diaphragm, resulting in miopization and reduction of anterior chamber depth. Phentermine has not been reported to cause BAACG. Our patient was instructed to discontinue the Qsymia.
Conclusion: This case report highlights the potential of a new FDA-approved weight loss medication Qsymia to cause bilateral acute angle closure glaucoma.

30. Fentanyl Patch Ingestion in an Infant with Endoscopic Retrieval

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Background: Transdermal fentanyl patches are frequently used for prolonged analgesia in chronic pain syndromes. Previous cases of intentional fentanyl patch ingestion resulting in clinical opioid toxicity have been reported. There are no prior reports of management of fentanyl patch ingestion in an infant.
Hypothesis: Fentanyl patch ingestion by an infant may be amenable to endoscopic removal.
Methods: This is a single-patient chart review. An 8-month-old female was sleeping on her grandmother's chest when she suddenly lost postural tone. She was noted to be apneic with perioral cyanosis. Following a blind finger sweep, mouth to mouth resuscitation was performed. On arrival at a local hospital, she was noted to have agonal respirations and decreased muscle tone so she was intubated. On exam, she was noted to have pinpoint pupils and when her grandmother looked for the 75 μg/h fentanyl patch she had been wearing on her chest, she was unable to find it. The patient was given a trial of naloxone (0.05 mg) with return or muscle tone and pupillary response. After 2 h, she once again was noted to have decreased muscle tone and pinpoint pupils which again responded to naloxone (0.086 mg). A pediatric gastroenterologist was consulted and endoscopy was performed to attempt fentanyl patch retrieval.
Results: A single 75 μg fentanyl patch was retrieved from the esophagus resulting in gradual resolution of opioid toxicity.
Discussion: The amount of fentanyl contained in a single trans-dermal patch can cause significant morbidity and mortality. In our case, we calculated a total of 12.375 mg of fentanyl was contained in a single 75 μg patch. Ingestion of the patch can result in prolonged opioid toxicity. Treatment with naloxone can dramatically reduce the respiratory, neurologic, and gastrointestinal effects of fentanyl, but enhanced elimination techniques could also be considered. Endoscopic removal can be attempted, particularly in younger patients where the patch may become entrapped in the esophagus or stomach. In patients older than 9 months, whole bowel irrigation could also be considered.
Conclusion: Endoscopic retrieval is an effect means of removing ingested sustained release patches in infants.

31. Wide Variation in Naloxone Dosing Recommendations for Acute Opioid Toxicity

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Background: Opioid intoxication is an increasingly common reason for an emergency department visit. Naloxone, a competitive mu-opioid receptor antagonist, can be used judiciously to reverse hypoventilation, but in excess, can precipitate opioid withdrawal syndrome (OWS) in opioid-dependent patients. The optimal dose of naloxone remains controversial, particularly in this latter group.
Research question: What naloxone dose do authoritative sources recommend to treat opioid-induced hypoventilation?
Methods: A convenience sample of textbooks, study guides, and internet resources published within the last 10 years in the fields of emergency medicine (EM; four), anesthesiology (four), medical toxicology (MT; four), pediatrics (two), internal medicine (IM; two), and general medicine (ACLS, pharmacology reference, and internet resources; six) were reviewed for their recommended naloxone initial dosing, dose range, and titration protocol for opioid toxicity.
Results: Twenty-two resources were identified that provided a naloxone dose recommendation. Of these, 12/22 (55 %) recommended an initial dose of 0.04 or 0.05 mg IV and 9/22 (41 %) suggested 0.4 or 0.5 mg IV. The maximum dose by titration recommended by source was 2 mg in six, 10 mg in eight, and 20 mg in two. No trend towards lower recommended dosage was noted based on year of publication (R^2=0.012). An initial dosage less than 0.1 mg recommended by source was 3/4 MT, 3/4 anesthesia, 4/6 general medicine, and 2/4 EM. No IM or pediatric sources recommended an initial dose less than 0.4 mg.
Discussion: Low-dose naloxone is highly effective in reversing ventilatory depression, and though it is slower in onset than higher doses, OWS is less concerning. The increase in chronic opioid therapy for pain and an

increase prevalence of opioid abuse raises the likelihood of OWS following naloxone. Recent data suggests an initial naloxone dose of 0.04 mg IV is preferred.
Conclusion: Wide variation in the naloxone dose recommended for acute opioid toxicity is noted in sources with the potential for patient harm due to OWS. Clinical studies are needed to evaluate whether lower doses are efficacious and provide greater safety for opioid intoxicated patients.

32. Severe Mercury Poisoning in a Pediatric Patient Due to Mexican Facial Cream Use

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Background: We report a case of severe mercury (Hg) poisoning in a pediatric patient due to Mexican facial cream use.
Hypothesis: Hg poisoning in pediatric patients can occur with topical use of facial creams containing inorganic Hg.
Methods: A healthy 17-year-old boy presented with insomnia, lower extremity muscle weakness, extremity tingling, and low back pain. He reported a loss of balance and coordination while playing soccer. Later, he developed hypertension (148/84 mmHg) and extremity fasciculations. Initial workup revealed normal CBC, CK, UA, serum electrolytes, Ca, Mg, CRP, TSH, AST, and MRI of the spine. An EMG revealed diffuse myopathic fasciculations. Prednisone resulted in no significant improvement. His symptoms worsened including severe fasciculations, hallucinations, ataxia, hypertension (170/90 mmHg), and tachycardia (150 bpm). He was admitted to the pediatric intensive care unit due to hyperadrenergic signs and hallucinations. Initial working diagnosis was pheochromoctyoma. Morvan's fibrillary chorea was then presumed and a 5-day course of IVIG was administered. Three generalized seizures developed. A medical toxicology consultation was then requested.
Results: Toxicology lab testing revealed elevated blood Hg levels of 208 μg/L. Home inspection revealed unlabeled jars of acne facial cream from Mexico containing mercurous chloride (96,00–210,000 ppm Hg). Lumex measurements in the patient's room were 2.6 μg/mm^3. The patient used facial cream daily for 6 weeks and stopped 1 month prior to the first Hg level. Treatment included a full course of succimer. Hypertension was managed with diltiazem. Sleep and pain were managed with amitriptyline. Fasciculations, back pain, insomnia were present at 3 months. At 6 months follow-up, he had rejoined his soccer team but continued on diltiazem for persistent hypertension and tachycardia.
Discussion: It is important to obtain a full medication history in adolescents using various acne treatments. Hg poisoning in pediatric patients is most commonly confused with pheochromocytoma and Kawasaki's disease. Patients presenting with similar symptoms yet an incomplete picture should prompt an evaluation for Hg poisoning.
Conclusion: Determination of Hg toxicity may be challenging. Awareness of acne treatment facial products may prompt an early diagnosis of Hg poisoning. This case demonstrates collaboration between local and state health departments and a toxicology service.

33. Food-Borne Poisonings and Infectious Diseases from Survivor Program Copycat Behaviors

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Background: Popular survivor television programs feature outdoorsmen recommending that novices survive wilderness experiences by consuming edible raw animals and plants.
Research Question: Do survivor copycat behaviors result in potentially fatal food-borne infections and poisonings?
Methods: In case series analyses, internet searches identified poisonings and infections following consumption of raw plants and animals with poisonings confirmed by positive chromatography and infections defined by positive microscopic, serologic, or molecular diagnostics. Statistical significance was defined by p values ≤ 0.05 with continuous variables analyzed by t tests and categorical variables by chi-squares (X^2).
Results: Thirty-eight cases of neuroangiostrongyliasis (NAS) with eosinophilic meningoencephalitis and 16 cases of paragonimiasis (PG) with hemorrhagic pneumonitis followed consumption of raw animals infected with causative parasites, rat lungworms (*Angiostrongylus cantonensis*), and American lung flukes (*Paragonimus kellicotti*), respectively. The mean age of NAS cases was 21.5 years, mostly males (P=0.039, X^2) from Hawaii (P=0.039, X^2) who consumed raw snails or frogs (P=0.003, X^2). The mean age of the PG patients was 27.3 years with one death, mostly males from Missouri (P<0.0001, X^2) who consumed raw crayfish (P<0.0001, X^2) while intoxicated (P=0.028, X^2). Six cases of plant poisonings were reported in five males with mean age of 26.4 years and one female (age 14). Four plant poisonings with three fatalities followed consumption of water hemlock (*Cicuta maculata*). Two fatalities followed consumption of poison hemlock (*Conium maculatum*). In fatal plant poisonings, hemlocks were misidentified as either wild carrot or ginseng. There were more infections then poisonings, but plant poisonings caused more fatalities than parasitic infections (P<0.0001, X^2).
Discussion: Risk factors for infectious diseases from survivor copycat behaviors included male gender and consumption of raw animals while intoxicated outdoors. Risk factors for plant poisonings from survivor copycat behaviors included male gender and misidentification of poisonous plants as nonpoisonous. Recommended preventive interventions included proper preparation of self-harvested natural foods, wilderness survival training, and alcohol avoidance.
Conclusion: Survivor copycat behaviors resulted in significant risks for parasitic infections and fatal plant poisonings in young males consuming raw animals and plants during outdoor experiences when intoxicated.

34. Succimer Chelation Therapy Safely Used for Lead Poisoning in Pregnancy

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Background: The 2008 National Health and Nutrition Examination Survey suggested that ~1 % of women of childbearing age have elevated blood lead levels (BLL). Although research is lacking, edetate calcium disodium is the preferred chelating agent because of its familiarity in this setting. There is a paucity of cases utilizing succimer (DMSA) during pregnancy; one case demonstrated no improvement in maternal BLL.
Methods: A 19-year-old female (G1P0) at 27 weeks gestation (WG) presents to her obstetrician with bone pain reminiscent of elevated BLL. She was first diagnosed with lead poisoning at 2 and received DMSA repeatedly. At 15, her levels had plateaued near "normal" after removal of a tongue stud verified to contain lead. Her BLL at 28 WG is 42.9 μg/dL. Medical toxicology is contacted when her BLL is 101 μg/dL at 34 WG. The patient denies pica and refuses hospital admission. After negotiation, the patient starts DMSA at home at 500 mg every 8 h (5 days) and then every 12 h (2 weeks). After she completes DMSA and removes two new tongue studs, her BLL is 32 μg/dL. She is induced at 37 WG, and a 2,790 g baby boy is vaginally delivered with APGAR scores of 9 at both 1 and 5 min. Cord and neonate BLL are 46 and 50 μg/dL, respectively. After she takes DMSA for 19 days, her BLL is 33 μg/dL.
Discussion: The tongue studs are not verified lead sources; however, the patient's home revealed no source. Pica remains a common source of lead in pregnancy. Although chelating agents may cause teratogenicity in animals due to loss of essential nutrients, in most cases of prenatal chelation, infants develop normally in the short term. A case of DMSA prenatal chelation (maternal BLL, 44 μg/dL at 7 months gestation)

resulted in cord BLL of 126 μg/dL at 37 WG, but infant was "normal" per pediatrician at 6-month follow-up.
Conclusion: Although one prior case report lacked significant improvement in maternal BLL after DMSA chelation, our case demonstrates that DMSA is a viable and safe option in pregnancy. Source removal remains most important in lead poisoning management.

35. Phencyclidine Intoxication Observational Survey

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Background: Phencyclidine (PCP) is a synthetic compound derived from piperdine and used as an anesthetic and hallucinogenic. Little has been published regarding the clinical presentation of PCP intoxication. PCP use as a recreational drug is resurging.
Objective: This study aims to quantify the incidence of clinical and behavioral findings in patients presenting to the emergency department (ED) under the influence of PCP.
Methods: A prospective, observational study was conducted in a tertiary care center with an annual census of 90,000 patients/year. Physicians and research assistants identified patients with possible PCP intoxication, along with bystander/EMS and self-reported ingestions. A structured data collection form was completed obtaining both clinical and behavioral events observed during the ED visit.
Results: We enrolled 179 patients, and two patients were excluded secondary to lost data. The mean age was 32 years old (20–53) and 64 % were male. Approximately half (47 %) self-reported PCP use. On arrival, 78 % of patients were awake and alert, and 48 % were oriented to self, time/date, and place. Mean physiological parameters were HR-101 bpm, RR-18 bpm, BP-146/86 mmHg, temperature-36.9 °C, and pulse oxymetry-98 %. Clinical findings were 73 % amnesia, 64 % horizontal nystagmus, 52 % vertical nystagmus, 50 % hypertension, and 40 % agitation. Co-ingestions were reported 35 % of the time, 25 % with marijuana and 21 % with ETOH. Out of 177 patients, 153 had positive urine drug screens (UDS). PCP was positive in 152 (99 %), 63 positive for THC (41 %), 39 positive for benzodiazepines (BZD; 25 %), and 19 positive for opiates (12 %). The mean length of stay was 266 min, with 86 % discharged, 8 % admitted, and 6 % transferred to psychiatry.
Conclusion: Patients with PCP intoxication tended to be young males. Prevalent clinical signs and symptoms were: amnesia, nystagmus, hypertension, and agitation. Co-ingestions were the norm; however, 25 % of patients with a positive UDS received BZD in the ED, therefore it may not represent a co-ingestant. The majority of patients had minimal alteration in vital signs and was discharged once their symptoms resolved. The increasing prevalence of PCP use as a recreational drug requires a better understanding of its clinical presentation.

36. High Dose, Variable Length, *N*-acetylcysteine (HINAC) Therapy for Late-Presenting Acetaminophen Poisoning

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Introduction: Two previous studies have demonstrated a decreased mortality from 58–80 to 37–52 % for patients with late-presenting acetaminophen poisoning who were treated with Prescott's *N*-acetylcysteine protocol. Since 1998, we have utilized a high dose, intravenous, variable length, and *N*-acetylcysteine (HINAC) regimen for patients with acetaminophen poisoning described as a 140 mg/kg loading dose of *N*-acetylcysteine followed by 70 mg/kg every 4 h until the transaminases begin to decline.
Objective: This study aims to describe our clinical experience of HINAC therapy for the treatment of late-presenting acetaminophen-poisoned patients.
Methods: A retrospective, observational chart review of an institutionally-approved HINAC protocol from 1998 to 2013 at two toxicology centers. Inclusion criteria included HINAC administration >24 h post-ingestion and/or initial transaminases twice the upper limit of normal with history of >8 g of ingested acetaminophen. Patients were excluded by inadequate data, dosing deviation from HINAC protocol of >25 %, and chronic ingestion (>2 ingestions, separated by >8 h). Our primary outcome was death. Secondary outcomes included liver failure (defined by transaminases >1,000 IU/L), King's College laboratory criteria for poor prognosis and anaphylactoid reactions. Outcomes were compared to previously published NAC regimens.
Results: There were 74 patients who presented after 24 h with a median age of 31 years (range, 1–71). Forty-nine (66 %) were female, 18 (24 %) had history of chronic ethanol abuse, and 4 had history of hepatic disease. Sixty-five (88 %) of the ingestions were suicidal and the average time from ingestion to presentation was 34 h (range, 24–88). Forty-seven had detectable acetaminophen levels with median of 80.5 μg/ml (range, 2–516). The median number of doses of HINAC received was 7 (range, 2–26). Forty-five (61 %) had peak aspartate aminotransferase (AST) >1,000 U/L and the median peak AST was 2,756 U/L with range of 18–23,470. Forty-three (58 %) had peak alanine aminotransferase (ALT) >1,000 U/L and the median peak ALT was 3,184 with a range of 11–17,658. Fourteen patients met at least one King's College criteria (2 with protime, >100 s; 16 with creatinine, >3.3 mg/dl; and 9 with pH<7.3) and there were five deaths (two non-acetaminophen). Four (0.5 %) patients had anaphylactoid reactions.
Conclusions: Patients with late-presenting acetaminophen poisoning who are treated with HINAC have decreased mortality compared to previous studies ($p<0.0001$)

37. Bedside Evaluation of Adverse Drug Events by Medical Toxicologists

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Background: Adverse drug events (ADEs) are defined as untoward outcomes associated with the use of a drug, including adverse reactions and medication errors. ADEs contribute significantly to iatrogenic morbidity and mortality and are generally preventable. Medical toxicologists (MTs) may be consulted in the care of patients with ADEs due to severity of symptoms and their expertise in antidote use, drug interactions, and care of poisoned patients.
Research question: We sought to describe the clinical characteristics of ADEs leading to bedside toxicology consultation.
Methods: The ToxIC registry from January 2010 to October 2013 was examined to identify ADEs as the primary reason for consultation. These cases were analyzed for patient demographics, classes of drugs involved, presence of toxidromes, and clinical findings.
Results: A total of 309 ADEs were identified involving 166 women and 143 men. Patients were between the ages of 19–65 (206), age >65 years old (64), and age <18 years old (37). There were 241 cases involving 1 drug and 51 cases involving more than 1 drug. Fourteen cases did not describe the drug involved. The most common drugs/classes of drugs involved were: sedative hypnotics (71), opioids (62), antidepressants (48), cardiovascular drugs (36), anticholinergic/antihistamines (33), antipsychotics (32), anticonvulsants (24), analgesics (22), lithium (17), local anesthetics (6), stimulants/sympathomimetics (5), diabetic medications (4), nutritional supplements (4), chemotherapeutics (3), and antidotes (3). In 285 cases, patients developed clinical effects from the ADEs. Toxidromes were present in 90 cases with 6 patients experiencing more

than 1 toxidrome: opioid (8), sedative-hypnotic (24), anticholinergic (24), cholinergic (2), sympathomimetic (3), withdrawal (7), serotonin syndrome (26), and NMS (2). Cardiovascular effects (91 cases) included heart rate and electrocardiogram abnormalities. Pulmonary findings (35 cases) were primarily respiratory depression. Neurologic abnormalities (196 cases) included altered mentation and seizures. Metabolic derangements (26 cases), gastrointestinal or hepatic abnormalities (31 cases), and renal injury or rhabdomyolysis (35 cases) were also frequently present.
Discussion/Conclusions: MTs consult on a wide range of ADEs in patients of all ages. Toxidromes or organ-specific findings are often present and may lead clinicians to seek expert advice. Further analysis of this and similar cohorts may generate ADE prevention strategies.

38. Characteristics of Patients Presenting to a Medical Toxicologist for Exposure to Heavy Metals

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Background: Adult patients commonly present to medical toxicologists for evaluation of potential heavy metal exposure, but are poorly characterized in the toxicology literature.
Research question: This study aims to characterize patients who present to a medical toxicologist for evaluation of heavy metal exposure.
Methods: An advanced search of the ACMT Toxicology Investigators Consortium database was performed from the January 1, 2010 through October 10, 2013 for exposure to heavy metals (see Table for individual metals). Exclusion criteria were less than 18 years of age or age range not recorded. Additionally, acute iron exposures were excluded. The following data were collected: demographics, source of referral, reported signs or symptoms, and therapy provided.
Results: Fifty-four adult patients were identified. Of these, 55.5 % of patients were male, with an average age of 52 (SD, 16.2). Reasons for referral were predominantly interpretation of prior lab data (31, 57.4 %), unintentional nonpharmaceutical exposures (17, 31.5 %), and organ dysfunction (7, 13 %). The most common exposures were cobalt (21, 38.9 %), chromium, and mercury (13, 24.1 % each). Fifteen patients reported exposures to more than one metal. Thirty-seven (68.5 %) patients had symptoms reported. The most frequent were numbness/paresthesias (eight, 21.6 %), rash (four, 10.8 %), nausea/vomiting (two, 5.4 %), peripheral neuropathy (two, 5.4 %), and hemolysis (two, 5.4 %). Only six patients (11.1 %) were judged to have symptoms most likely related to a toxicological exposure. Eight patients (14.8 %) received toxicological treatment, including four of the six patients with symptoms likely related to a toxicological exposure. Three patients received chelation with succimer, while one also received vitamin C, and another received dimercaprol, gastric lavage, whole bowel irrigation, and intravenous fluids. The fourth was treated with intravenous fluids.
Conclusion: This review of database information on adult patients presenting to a medical toxicologist for evaluation of heavy metal exposure finds that these patients are more often men referred by a primary care doctor or other outpatient physician. The most common exposures were cobalt, chromium, and mercury. Limitations include reliance on providers to enter information, resultant incomplete data entry, or potential reporting bias towards more unusual cases.

Table (Abstract 38). Characteristics of patients with heavy metal exposures

Demographics							
Age	Range, 20–89	Mean, 51.6; (SD 16.2)	Median, 51	Mode, 44	Only age range 19–65 or >65 reported 9 (16.7 %)		
Gender	Male, 30 (55.5 %)	Female, 24 (44.4 %)					
Referral							
Source	Primary care physician or other outpatient physician, 26 (48.1 %)	Self-referral, 13 (24.1 %)	Emergency department, 8 (14.8 %)	Admitting service, 4 (7.4 %)	Employer/independent medical evaluation/ workmen's compensation 1 (1.9 %)	Poison center, 1 (1.9 %)	
Reason*	Interpretation of laboratory data, 31 (57.4 %)	Unintentional nonpharmaceutical exposure, 17 (31.5 %)	Organ dysfunction, 7 (13 %)	Environmental evaluation, 5 (9.3 %)	Occupational evaluation, 3 (5.6 %)	Other, 2 (3.7 %)	None listed, 4 (7.4 %)
Exposure							
Metal exposure	Cobalt, 21 (38.9 %)	Chromium, 13 (24.1 %)	Mercury, 13 (24.1 %)	Lead, 8 (14.8 %)	Arsenic, 4 (7.4 %)	Copper, 4 (7.4 %)	Other, 5 (9.3 %)
Symptoms							
Symptom	Numbness/ paresthesias, 8 (14.8 %)	Rash, 4 (7.4 %)	Hemolysis, 2 (3.7 %)	Nausea/ vomiting, 2 (3.7 %)	Peripheral neuropathy, 2 (3.7 %)	Other, 8 (14.8 %)	Symptom not reported, 18 (33.3 %)
Related to exposure	Most likely related, 6 (11.1 %)	Unlikely related, 21 (38.9 %)	Unknown if related, 8 (14.8 %)	No response, 19 (35.2 %)			
Treatment							
Treatment given?	Yes, 8 (14.8 %)	No, 45 (83.3 %)	No response, 1 (1.9 %)				
Type of treatment	Chelation, 3 (37.5 %)	IV fluids, 2 (25 %)	Gastric lavage, 1 (12.5 %)	Prosthetic hip revision, 1 (12.5 %)	*N*-acetylcysteine, 1 (12.5 %)	Whole bowel irrigation, 1 (12.5 %)	Vitamin C, 1 (12.5 %)

*% total >100, more than one response possible for each

39. Does Patient Education in the Emergency Department Increase Awareness that Acetaminophen is Contained in Percocet?

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Background: Acetaminophen overdose is a commonly reported overdose in the USA. There are multiple opioid-acetaminophen combination medications on the market. The percentage of people with acute liver failure associated with unintentional acetaminophen overdose is increasing. Patients may be unaware that acetaminophen is contained in certain prescription medications.
Study objectives: Our study will assess if patients in the emergency department are aware that acetaminophen is contained in Percocet®. It will also evaluate if educating patients about their prescribed medication will increase their knowledge that Percocet contains acetaminophen.
Materials and measure: We performed a prospective randomized study on patients ages 19 years and older, who presented to the Emergency Department Fast Track, and were being discharged with an outpatient prescription for Percocet (or its generic equivalent). Upon discharge, patients in both the control and intervention groups were given a questionnaire to complete. Prior to answering the questionnaire, the intervention group was read a script with information about Percocet and acetaminophen. A percentage of patients were contacted after their encounter for a repeat phone questionnaire.
Results: A total of 55 patients were enrolled. The intervention group answered significantly more correct questions than the control group. A majority of patients in the control group were unaware that Percocet contains acetaminophen. At a 4-month follow-up, patient scores in the intervention group decreased while those in the control group increased.
Conclusion: Many patients do not know acetaminophen is contained in Percocet and even if educated, they may not retain this information.

40. Naloxone Administration in the Pediatric Population According to ToxIC Database Reporting

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Background: In 2009, ACMT established the Toxicology Investigators Consortium (ToxIC). This network was constituted to promote multicenter research in toxicology and enable the nationwide collection of important toxicological data from patients at the bedside. We used the ToxIC database to investigate characteristics of pediatric patients receiving naloxone over 1 year.
Research question: What are the characteristics of patients age 18 years and younger that received naloxone?
Methods: We searched the ToxIC database for all cases of patients who received naloxone from October 1, 2012 to September 30, 2013. Patients ages 18 years and younger were examined and divided in four groups: age <2, 2–6, 7–12, and 13–18 years. Patients were evaluated for sex, type of exposure, and indication for naloxone administration and specific xenobiotic implicated.
Results: Five hundred fifty-seven patients were recorded as given naloxone during the study period. Sixty-eight (12.2 %) of the patients were 18 years and younger; of these, 14 (2.5 %) were <2 years, 17 (3.1 %) were 2–6 years, 4 (0.7 %) were 7–12 years, and 33 (5.7 %) were 13–18 years. The number of males were greater than females in all groups except the 7- to 12-year group (males=females). For ages <2, 2–6, and 7–12 years, unintentional pharmacologic exposure was associated with receiving naloxone in 85.7, 88.2, and 50 % of cases, respectively. Patients of 13–18 years had 0.0 % unintentional pharmacologic exposures. Patients received naloxone for coma and/or respiratory depression in 78.6 % for the <2-year group, 76.5 % in the 2- to 6-year group, 100 % in the 7- to 12-year group, and 60.6 % in the 13- to 18-year group. The proportion of xenobiotics associated with naloxone administration in each age group was calculated. The most common xenobiotics associated with naloxone administration were buprenorphine (17.7 %), oxycodone (13.2 %), and clonidine (11.8 %).
Discussion: The prescription opioid abuse epidemic results in increased availability of opioids in the home. The ToxIC database shows that naloxone use in children is mostly due to unintentional pharmacologic exposures which support this. The most common xenobiotic implicated was buprenorphine.
Conclusion: According to the ToxIC database, the most common cause for naloxone administration in the pediatric population was unintentional pharmacologic exposure.

41. Poisoning During Pregnancy: Observations from the Toxicology Investigators Consortium (ToxIC) Case Registry

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Background: Poisonings during pregnancy are a particular health concern because they may have serious, life-long implications for the mother and fetus.
Study aim: This study aims to explore recent exposure trends in pregnant women in the USA.
Methods: We identified all cases involving poisoning during pregnancy that were catalogued in the 37 sites of the Toxicology Investigators Consortium (ToxIC) Case Registry of the American College of Medical Toxicology between January 1, 2010 and December 31, 2012. We recorded clinical data including volition, agents involved, management, and outcome.
Results: Of 17,529 poisoning cases reported to the ToxIC Registry, 103 (0.6 %) involved pregnant women. The most common type of encounter was deliberate self-overdose (54 %, with a pharmaceutical agent [46 %] and a nonpharmaceutical agent [8 %]), followed by unintentional pharmaceutical exposure (10 %), and withdrawal (9 %). The most common classes of agents consumed were non-opioid analgesics (31 %), sedative-hypnotics/muscle relaxants (18 %), opioids (17 %), anticonvulsants (10 %), and antidepressants (10 %). Acetaminophen was ingested in 25 % of all cases. Thirty-seven percent of cases involved exposure to multiple drugs and 32 % involved exposure to more than one drug class. Seventy-nine patients (77 %) were symptomatic. Twenty-nine percent manifested a specific toxidrome, with sedative hypnotic being the most common (13 %), followed by toxidrome withdrawal (5 %), mostly from opioids. Central nervous system depression was present in 17 % of cases (71 % of whom involved sedative hypnotic/muscle relaxants). Tachycardia was present in 15 % of the cases; 6 % developed acetaminophen-induced hepatotoxicity. The most common antidotes administered were *N*-acetylcysteine (20 %), sodium bicarbonate (9 %), flumazenil (4 %), and physostigmine (4 %). All six patients with carbon monoxide therapy underwent hyperbaric oxygen therapy. Twenty-three percent of women did not receive any treatment, despite the fact that 42 % of them were symptomatic.
Discussion: Most pregnant women presenting to hospital with acute poisoning were engaged in self-harm or suicidal behavior, and the majority were symptomatic. As roughly half of untreated pregnant women were symptomatic, prospective studies should explore whether pregnant patients are treated less aggressively than their nonpregnant counterparts and pregnancy outcomes.
Conclusion: Most acute poisoning cases in pregnant women are intentional (self-harm) and symptomatic.

42. Vilazodone May Cause Sodium Channel Blockade in Overdose

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Background: Vilazodone (VIIBRYD®), recently FDA approved in 2011 as an antidepressant, has enjoyed rapid popularity due to initial reports of a milder side effect profile. The few reported cases of toxicity of this 5-HT1A partial agonist and selective serotonin reuptake inhibitor (SSRI) have described symptoms consistent with serotonin syndrome. However, none provided confirmatory serum levels or mention cardiac sodium channel blockade as an adverse effect.
Hypothesis: Vilazodone toxicity can cause cardiac sodium channel blockade in overdose.
Methods: This is a single-patient chart review. A 15-year-old adolescent boy intentionally ingested 780 mg of vilazodone in a suicide attempt. Three hours after ingestion, the patient exhibited signs of serotonin syndrome including severe agitation, bilateral five-beat ankle clonus, knee hyperreflexia with normal upper extremity reflexes, and tachycardia. An electrocardiogram obtained after transfer to a tertiary care center demonstrated evidence of sodium channel blockade with a QRS duration of 130 ms.
Results: Due to demonstrable sodium channel effects on the ECG, the patient was administered 200 mEq sodium bicarbonate IV bolus and started on an infusion (D5W+150 mEq $NaHCO_3$+40 mEq KCl) at 150 mL per hour. Six hours after the initiation of the bicarbonate infusion, the QRS narrowed to 96 ms. At 9 h post-ingestion, a serum level of vilazodone was found to be 830 ng/mL (normal reference, <156 ng/mL). The patient was extubated on hospital day (HD) 2 following return of baseline mental status. He was discharged without sequelae to an inpatient psychiatric hospital on HD 3.
Discussion: There are only six cases of reported vilazodone toxicity. Serotonin syndrome has been previously reported, but no cases have reported cardiac toxicity or provided confirmatory vilazodone levels. The ECG changes seen in this case were similar to other known sodium channel blockers in the Vaughan Williams IA and IC antidysrhythmics classes. Based on experience with other sodium channel antagonists, we recommend sodium bicarbonate administration as a treatment for QRS widening due to vilazodone toxicity.
Conclusion: This case illustrates the clinical course of a confirmed vilazodone overdose, with emphasis on the development of cardiac toxicity and need for cardiac monitoring.

43. *N*-Acetylcysteine (NAC) Induced Hyponatremia caused by an EMR Order Set Error

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Background: Intravenous *N*-acetylcysteine (NAC) causes few adverse drug events with anaphylactoid reactions being the most common. A case of hyponatremia from NAC's hypoosmolar diluent was reported in 1967, but this occurred before electronic medication ordering was commonplace.
Hypothesis: We hypothesize that a poorly constructed electronic medical record (EMR) order set for IV NAC may result in seizures from hyponatremia due to excess free water administration.
Methods: This is a single-patient chart review of a 13-month-old female with no past medical history who presented to a hospital after ingesting Tylenol extra strength. The 4 h acetaminophen level was 343 μg/mL and she was started on IV NAC. Twelve hours later, she developed a tonic-clonic seizure with sodium at that time measuring 124 mEq/l, a decrease from 142 mEq/l at the time of admission. She was treated with hypertonic saline, lorazepam, levetiracetam, and had no further seizures. A brain MRI and EEG were normal.
Results: The EMR ordering system did not allow for volume adjustment of NAC for a young child. The NAC dose was correct; however, the diluent volume was a standard amount for an adult but not an 8 kg child, the first bag contained 150 mg/kg of NAC in 200 mL of D5W, the second contained 50 mg/kg in 500 mL of D5W, and the third contained 100 mg/kg in 1,000 mL of D5W (with total of 900 mL given at the time of seizure).
Discussion: Because the 21-h IV NAC administration involves preparation of three different bags, an order set was developed to reduce ordering errors. With the exception of patient's weight, no other aspect of this order set was adjustable (including diluent choice or volume of preparation). These preset values caused the pharmacist to prepare a solution that contained too much free water, decreasing patient's intravascular sodium and resulting in a seizure.
Conclusion: Development of an order set intended to reduce ordering errors may lead to an adverse drug error if volume of diluent cannot be adjusted for pediatric patients.

44. Comparison of Alcohol Withdrawal Outcomes in Patients Treated with Benzodiazepines Alone Versus Adjunctive Phenobarbital: A Retrospective Cohort Study

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Background: Phenobarbital is a long-acting barbiturate with evidence for use in the treatment of alcohol withdrawal including planned detoxification and symptomatic control during acute withdrawal syndromes. Patients with severe withdrawal or delirium tremens are clinically challenging, requiring high doses of benzodiazepines for prolonged periods placing them at risk for oversedation, mechanical ventilation, and benzodiazepine-induced delirium. Rapid control using phenobarbital loading doses may reduce these risks and improve symptom management.
Research question: Does the addition of phenobarbital to benzodiazepine therapy improve symptom control and decrease duration of withdrawal?
Methods: This was a retrospective cohort study of patients admitted to an academic medical center. Subjects were identified through electronic medical record reports for intravenous phenobarbital or intravenous/oral benzodiazepine orders for alcohol withdrawal from March 1, 2011 to October 31, 2012. Included subjects had a diagnosis of alcohol withdrawal, at least one Clinical Institute Withdrawal Assessment of Alcohol Scale, Revised (CIWA-Ar) score >10, received one dose of phenobarbital in the phenobarbital group, and three doses of 20 mg diazepam equivalents within 6 h in the benzodiazepine group. Exclusion criteria included ICU admission for initial treatment and positive urine toxicology screen. The primary endpoint, the proportion of patients 24 h after initial treatment with a CIWA-Ar score <10, was compared using Fisher's exact test. Duration of withdrawal and cumulative doses were analyzed via Mann–Whitney *U* test.
Results: Seven patients in the adjunctive phenobarbital and 21 in the benzodiazepine group were included in the final analysis. Forty percent in the phenobarbital group versus 23.8 % in the benzodiazepine group met the primary endpoint (p=NS, Fisher's exact test). Secondary objectives appear in the table.
Discussion: Although symptom control at 24 h was not statistically different between groups, diazepam equivalent doses were significantly decreased with adjunctive phenobarbital treatment. The phenobarbital dose requirement was similar to previously reported doses. Limitations include potential selection bias due to differences in withdrawal severity in the phenobarbital group and small sample size.
Conclusions: Phenobarbital appears to be a safe and effective alternative to benzodiazepines for the treatment of alcohol withdrawal in noncritically ill patients and may be benzodiazepine sparing.

Table (Abstract 44). Secondary objectives

	Adjunctive phenobarbital Median (IQR)	Benzodiazepines alone Median (IQR)	*p* value
Duration of withdrawal (hours)	44 (12–62)	53 (37–87)	NS Mann–Whitney *U* test
Cumulative benzodiazepine dose (mg diazepam equivalents)	25 (20–226)	326 (160–550)	$p=0.02$ Mann–Whitney *U* test
Cumulative phenobarbital dose (mg)	455 (309–618)	–	–

45. Massive Atenolol and Lisinopril Overdose Treated with Hemodialysis, Impella® Heart Pump Device, ECMO, and Endoscopic Decontamination

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Background: Atenolol is a cardioselective beta antagonist. We present a case of a massive atenolol overdose and lisinopril treated with multiple modalities, resulting in an excellent outcome.
Case: A healthy 44-year-old woman with a history of depression ingested 90 tablets of atenolol 50 mg/chlorthalidone 25 mg and an unknown quantity of 40 mg lisinopril tablets. These medications were prescribed to her boyfriend. In the emergency department, systolic blood pressure was 59 mmHg, HR 49 bpm. She remained hypotensive despite fluid boluses, a glucagon bolus and drip, and a norepinephrine drip. She required intubation for declining mental status. Phenylephrine and epinephrine drips were started upon transfer. Three hours after ingestion, HR was 45 bpm and BP was 62/43 mmHg. Examination was otherwise unremarkable. Initial bedside ECHO revealed good contractility. The infusions included: epinephrine at 50 μg/min, norepinephrine at 100 μg/min, phenylephrine at 200 μg/min, and glucagon at 10 mg/h. She was started on CVVHD. An Impella® LD device and intravenous pacemaker were placed. MAP increased from 60 to 75 mmHg. EGD was done 16 h post-ingestion and revealed a large load of pill fragments (picture), which were suctioned and removed. Twenty hours after ingestion, her cardiac output decreased to only that provided by the Impella® device. Five days after admission, the Impella® device was weaned, but the patient was unable to be oxygenated and was placed on extracorporeal membrane oxygenation (ECMO) for ARDS. ECMO was used for 2 days to support her oxygenation. Beta blockade effects appeared to resolve 5 days into her hospitalization. Vasopressors and mechanical ventilation were weaned by days 7 and 11, respectively. Full renal function and good recovery were complete in 30 days.
Discussion: Atenolol is almost entirely renally excreted. We present levels demonstrating removal with CVVHD. This is the first case reported of using the Impella® device for this overdose. This is the first report of EGD decontamination of atenolol overdose. The large pill fragments burden found and removed from this patient at 16 h after ingestion is somewhat surprising.

46. Phytophotodermatitis Resulting From Citrus Exposure: A Pediatric Case Series from Central California

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Background: Psoralens belong to the furocoumarin family, and cause phytophotodermatitis when coupled with ultraviolet light exposure. This phenomenon has been described in case reports from Sweden, Italy, Brazil, UK, and USA after exposures to wild parsnip, fig leaf tea, hogweed, carrot, and citrus.
Methods: This is a consecutive-patient case series of five girls aged 7–11 transferred from an outside facility for specialty burn center evaluation. Symptoms developed 24 h after playing with limes and lemons near a backyard swimming pool.
Results: The girls had skin findings of large flaccid bullae on an erythematous base over sun-exposed areas, not following any dermatomal distribution. Initially, parents were questioned regarding possible pool chemical exposure and abuse. Two girls required admission to the intensive care burn unit, one was admitted to the floor and two were discharged from the emergency department. Initial treatment for patients 1–3 included pain control with intravenous opioids, use of bacitracin ointment, and non-adherent Xeroform® and Adaptic® dressings. Clobetasol ointment was started on hospital day 2 on patients 1–3 and applied during dressing changes. Procedural sedation was required for dressing changes and debridement for patients 1, 2, and 3. Patients 4 and 5 were discharged home with bacitracin ointment and Xeroform® dressings. Following discharge, return visits were required for dressing changes in all five patients. Over the next 3 weeks, erythematous areas gradually became hyperpigmented. Plant specimens were identified by local botanists as Key Lime (*Citrus aurantifolia*) and Lisbon Lemon (*Citrus limon*).
Discussion: Few phytophotodermatitis outbreaks demonstrate such severity in multiple pediatric patients, requiring transfer to a burn center for management. Optimal management of severe psoralen toxicity is not well established. In these cases, supportive care and topical steroids were used with good result. Oral steroids and silver impregnated dressings may also be considered.
Conclusion: Psoralen phytophotodermatitis diagnosis requires a high index of suspicion and may be initially misdiagnosed as herpes zoster, lymphangitis, chemical burns, poison oak, or jellyfish envenomation. Although potential abuse or pool chemical burns were considered in these cases, it became clear that the lesions were actually due to citrus exposure.

Table (Abstract 46).

Patient identification	Age (years)	Total body surface area involved (%)	Distribution of skin findings	Clinical setting	Hospital length of stay (days)
1	7	10	Face, bilateral upper extremities	Burn unit	4
2	8	18	Face, bilateral upper and lower extremities	Burn unit	3
3	9	8	Face, hands, bilateral lower extremities	Pediatric floor	3
4	9	5	Lips, left thigh	Emergency department	<1
5	11	10	Bilateral anterior thighs, bilateral anterior forearms, lower abdomen	Emergency department	<1

47. A Haddon Matrix Model for Prevention of Iatrogenic Opioid Overdose

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Background: Iatrogenic in-hospital opioid toxicity results in a range of adverse drug effects, from sedation to potentially life-threatening CNS and respiratory depression. In order to prevent this avoidable cause of morbidity and mortality, a structured approached is required to identify risk factors for iatrogenic opioid overdose. This investigation aims to identify patient, provider, and systematic factors associated with iatrogenic opioid toxicity in the emergency department (ED).
Research question: Can the Haddon matrix, a well-defined injury prevention paradigm, be applied to in-hospital opioid toxicity?
Methods: A case series of iatrogenic opioid overdose from a large urban academic ED was identified through query of ED electronic medical records for ED visits during October 1, 2010 to December 31, 2011. Naloxone was used as a surrogate marker of overdose. Cases where prehospital naloxone was given were excluded. Cases of iatrogenic overdose in the ED were identified by naloxone administration after in-ED opioid administration. A committee consisting of a medical toxicologist, emergency physician, and patient safety pharmacist reviewed each case to determine category of harm and root cause of error. Cases were assigned a category of harm based on the National Coordination Council for Medication Error Reporting and Prevention Index [NCC MERP] classification scheme. Cases where harm resulted were used to construct a Haddon matrix.
Results: A total of 63 cases of iatrogenic opioid overdose were identified. The median age was 57 (range, 14–97), 60 % were female, and 42 (67 %) were determined to have experienced harm (NCC MERP categories E–H). Contributory factors were discussed for each case and recorded. Identified patient, provider (vector), and system factors were then used to construct the Haddon matrix displayed in Table 1.
Conclusions: We describe a Haddon matrix for iatrogenic in-hospital overdose, which identifies several modifiable factors. Focused interventions for high-risk patient populations and clinical settings, and pre-/post-event provider education could be effective at reducing iatrogenic opioid overdose in the ED setting.

Table (Abstract 47).

	Host	Vector (provider)	Environment (physical and social)
Pre-event	Age	Coadministration with other CNS depressants (e.g., benzodiazepines)	Adequate monitoring (oximetry, capnography)
	Alcohol intoxication	Failure to obtain accurate medication history	Cautious transitions of care
	Altered mental status (head injury, dementia)	Inappropriate use of opioid (patient altered or hypercarbic)	Communication failures
	Chronic obstructive pulmonary disease	No dose adjustment (hepatic, renal or geriatric)	Electronic ordering and overrides
	Dementia	Provider fatigue	Multiple providers
	Obesity	Provider inexperience	Pharmacy monitoring
		Route (IM or SC)	
Event	Anaphylaxis	Familiarity with naloxone dosing	Appropriate monitoring after procedural sedation
	Patient unable to participate in care (secondary to mental status depression)	Familiarity with naloxone duration of action	Appropriate monitoring during procedural sedation
		Knowledge of and adherence to procedural sedation guidelines	Availability of naloxone
		Recognition of opioid overdose	Availability of resuscitative equipment
		Error at delivery (wrong dose, concentration)	
Post-event	Hypercarbia	Adequate monitoring for recurrent symptoms	Debriefing with team
	Need for admission or higher level of care	Adequate observation period for recurrent symptoms	Review by medication safety
	Need for multiple naloxone doses		Formalized “trigger tool” review process
	Re-administration of opioids	Disclosure to patient	
	Recurrent CNS bradypnea	Provision of adequate discharge instructions	
	Recurrent CNS depression	Referral to peer review committee	

48. Improvement and Evolution of a Toxicology Consultation Billing Service

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Background: The University of Rochester Medical Center (URMC) Toxicology Consult Service (TCS) began on January 1, 2010. Adult and pediatric patients receive bedside consultation at two URMC hospitals. All consults are billed under a single board-certified medical toxicologist and include inpatient and outpatient (ED and clinic) encounters. We have previously described reimbursement over a 1-year period (July 2011–June 2012) including average monthly charges, revenue sources, and billing codes. Since presenting this data, billing charges and encounter types have increased. In July 2013, the total 1-month charges billed by the TCS were $94,508.00.
Research purpose: This study aims to describe the encounter types, billing codes, and reimbursement profiles from a TCS.
Methods: A review of consultation service billing records for July 2013 was performed. Encounter types, billing codes, diagnoses and charge profiles, as well as payer breakdown were reviewed. Information is compared to overall fiscal year 2012–2013.
Results: July 2013, total charges were $94,508 (62 % inpatient and 38 % outpatient) compared to FY12-13 monthly averages of $50,340 (57 % inpatient and 43 % outpatient). Of the work relative value units, 597.6 were generated. Net collection rate was 86.5 % in July 2013 (88.3 % average in FY12-13). There were 156 inpatient and 63 outpatient encounters and 15 procedures billed in July 2013 versus 79 inpatient, 39 outpatient, and 11 procedures on monthly average FY12-13. A total of 15 different billing codes were used in July 2013. Net collection rate for July 2013 was 86.5 % of claims submitted.

Discussion: Over the past several years, URMC has evolved its TCS to a point where significant income is being generated through inpatient and outpatient consultation, as well as clinic visits. However, it should be noted that at our institution this work has been conducted by a single toxicologist who has committed significant time and effort towards success.
Conclusion: A TCS can be supported financially with the appropriate support and structure. This service, when optimally operated can be of great benefit to patients, the community, as well as its associated medical center.

49. Clear and Preventable Danger?: A Haddon Matrix Safety Analysis of Injuries Sustained by Students Working in University Chemistry Laboratories

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Background: Recent media reports have highlighted the potential danger of working in an academic chemistry laboratory, most memorably with the stories of two students' deaths at UCLA and Yale. Despite the awareness raised by these events, our own toxicology service has noted a recent increase of patients presenting with laboratory-related injuries. It is not known what factors are contributing to this.
Hypothesis: A Haddon matrix analysis may reveal potential areas of vulnerability regarding safe laboratory practices among academic laboratory investigators, particularly students.
Methods: This is a case series of incidents wherein laboratory workers were inappropriately exposed to a chemical hazard. The consultation logs of our academic toxicology service from April 8, 2008 to October 3, 2013 were reviewed to compile a list of these cases, which were then cross-referenced with our electronic medical record. We collected variables regarding the characteristics of each incident (e.g. the name of the chemical, the safety equipment used, and medical outcome on follow-up). These variables were then used to construct a Haddon matrix (Table 1).
Results: Six different cases were identified, routes of exposure ranged from inhalation to ocular. Time of exposure ranged from seconds to 60 min, symptoms ranged from irritation to chest discomfort. The majority took place without the use of PPE, although two incidents happened despite use of safety equipment. There were no known long-term sequelae of these exposures.
Discussion: The utility of Haddon matrices is to analyze hazardous circumstances to determine prevention and mitigation strategies for future implementation. Examination of the Haddon matrices constructed from each of these cases yields common areas amenable to intervention: lack of personal protective equipment, improper storage conditions, lack of worker vigilance, improper spill containment/area clean-up, incongruous risk perception, incomplete adherence to existing safety practices, inadequate initial decontamination prior to ED arrival, and lack of witnesses during the exposure.
Conclusion: This data will be used to improve education materials and instruction for students in laboratory research and to support a culture of safety and prevention in our university laboratories.

Table (Abstract 49).

Phase	Host	Agent	Environment
Pre-exposure	• Inadequate education in safety practices • Inadequate awareness of potential of danger/injury • Lowered vigilance	• Improper storage conditions • Volatility of chemical	• Previous contamination of work area • Lab culture emphasizes productivity over safety • Lax employment screening
Exposure	• Lack of awareness of exposure • Prolonged exposure • Unfamiliarity with chemical properties • Incomplete adherence to existing safety practices	• Corrosive or otherwise hazardous chemical • Duration of exposure	• Nonfunctioning equipment or improper use of functioning equipment • Lack of a "buddy system" • Lack of PPE
Post-exposure	• Lack of awareness that exposure has occurred • Unaware needed medical attention • Inadequate decontamination • Fear of retaliation if reports injury	• Potential of agent to cause delayed reaction or injury	• Improper spill containment resulting in potential future exposure • No oversight within office to monitor injury

50. The ToxIC International Registry: Initial Glimpses from Medical Toxicology Consultation Services in Russia, Thailand, and Mexico

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Background: The international toxicology community has limited communication and collaboration mechanisms.
Research question: Is it feasible to develop an international registry of poisoned patients parallel to the American College of Medical Toxicology (ACMT) Toxicology Investigator's Consortium (ToxIC) Registry, an internet-based, multicenter toxicosurveillance network active in the USA since 2010?
Methods: We identified international colleagues with an interest or need in developing a registry of poisoned patients via online surveys and interviews. A web-based data entry form was developed to capture anonymized demographic, clinical, and management details of patients seen in bedside consults by international ACMT members. All entries was de-identified locally prior to registry enrollment, with periodic feedback via email or videoconference encounters provided to address logistical issues.
Results: The International ToxIC Registry has been active since February 1, 2013. ToxIC Investigators in urban settings in Russia, Thailand, and

Mexico entered a total of 235 cases involving 43 agents. One hundred ninety-six (83 %) patients presented with clinical signs of toxicity, while 39 were asymptomatic. The most common clinical presentations were confusion, CNS and respiratory depression, agitation/delirium, or anticholinergic toxidrome. GI decontamination was performed on 44 patients: 37 received gastric lavage and 10 received activated charcoal. Medical treatments, given to 55 patients, were benzodiazepines (44 patients), antipsychotics (11 patients), atropine (7 patients), as well as NAC, calcium, glucose, vasopressors, high-dose insulin euglycemic therapy, and intralipid (1 to 4 patients for each). The most common intoxicants (and number of cases) were synthetic cathinones (42), ethanol (30), antipsychotics (20), sedatives (19), carbon monoxide (12), cannabinoids (12), acid/corrosives (11), and opioids/heroin (6).
Conclusion: These initial data indicate that emerging drugs of abuse, prescription agents, and alcohol are well-represented intoxicants in urban toxicology practice settings worldwide. The increased use of gastric lavage over charcoal represents a trend which markedly differs from the USA and warrants further research. Our experience suggests that an international, web-based registry of bedside medical toxicology consultations is feasible. This project can create opportunities for global collaborative research and education among toxicologists with the ultimate goal of improving the care of poisoned patients worldwide.

51. Capsaicin Cream for Treatment of Cannabinoid Hyperemesis Syndrome

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Background: Cannabinoid hyperemesis syndrome (CHS) is described as cyclical episodes of nausea, vomiting, and abdominal pain associated with chronic and heavy cannabinoid use. The pathophysiology of CHS is poorly understood and published theories fail to explain the involvement of the endogenous cannabinoid system in the development of reported symptoms.
Hypothesis: Topical capsaicin will improve symptoms associated with CHS.
Methods: Prospective, nonblinded, nonplacebo-controlled trial of topical capsaicin preparation (0.075 %) in two patients with CHS. Case 1: A 19-year-old female presents to the emergency department for the third time in 1 week complaining of nausea, vomiting, and severe generalized abdominal pain. She previously underwent negative CT of the abdomen and pelvis, negative transvaginal ultrasonography, negative pelvic exam, and with the exception of mild hypokalemia, negative laboratory values. Further history revealed the patient has frequent and heavy use of marijuana. Her pain completely resolved when placed in a hot shower in the emergency department. She was treated for hypokalemia and when her pain and nausea returned, a trial of topical capsaicin cream was initiated. Her pain decreased from 8/10 to 4/10 and she was subsequently discharged home. Case 2: A 28-year-old man with history of cyclical nausea, vomiting, and abdominal pain for 3 years presents to the emergency department with return of his symptoms. His previous work up includes negative CT of abdomen and pelvis, negative EGD, and cholecystectomy. History revealed frequent and heavy marijuana smoking with improvement of symptoms upon exposure to hot water. A trial of topical capsaicin cream was initiated and the patient reported improvement in symptoms from 8/10 to 3/10. He was then discharged home.
Discussion: Capsaicin's only known receptor, TRPV1, is known to interact with endocannabinoids and plays a role in pain transmission. The results here suggest TRPV1 may play a role in the pathophysiology of CHS as well as indicate a safe and convenient therapeutic option for these often challenging cases.
Conclusion: Topical capsaicin therapy for CHS has potential as both a therapeutic modality and mechanistic probe that merits further investigation.

52. Intravenous Lipid Emulsion Therapy use in the Toxicology Investigators Consortium (ToxIC)

Levine M[1,2], Iwanicki J[3], Leikin JB[4,5], Donovan JW[6], McKay CA[7], Hernandez S[8], et al., for the Management with Intravenous Lipid in Overdose (MILO) investigators
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Background: In May 2012, the Intravenous Lipid Emulsion (ILE) subregistry was created as part of the ToxIC registry. The purpose of this subregistry is to prospectively collect detailed information regarding the use of ILE by toxicologists.
Objective: The primary objective of this interim analysis is to describe the patient characteristics for which ILE is being administered.
Methods: Retrospective review of prospectively collected data.
Results: Between 1 May 2012 through 30 October 2013, 44 patients received ILE. The subregistry analysis was complete on 34 of these patients. The 34 cases were derived from 17 different institutions. Males accounted for 13/34 (38.2 %) of subjects. The median (IQR) age was 48 (34.5–56)years, with the youngest patient being 13 months. ILE was administered most often for nondyhydropyrine calcium channel blockers (n=9), followed by dihydropyridine-class calcium channel blockers (n=5), or the combination of a beta blocker and a calcium channel blocker (n=4). ILE was administered for beta blockers alone in five subjects. Local anesthetics accounted for only three cases of ILE administration. Various other medications accounted for the remaining cases. Bradycardia (HR<50 bpm) was observed in 11/34 (32.3 %), while hypotension (systolic blood pressure <90 mmHg) occurred in 29/34 (85.3 %). Three patients experienced a high-grade AV block prior to ILE administration. Six (17.6 %) patients experienced cardiac arrest prior to implementation of ILE. In total, 10/34 (29.4 %) patients died. Acute kidney injury (creatinine >2.0 mg/dL) was present in 7/34 (20.6 %), while metabolic acidosis (pH <7.2) was present in 14/34 (41.7 %)
Conclusion: In this series of patients who received ILE, the majority of cases involved nonlocal anesthetics. Most patients were in shock and had evidence of abnormal tissue perfusion.

53. Prevention of Neonatal Abstinence Syndrome in the Setting of Intrauterine Baclofen Exposure

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Background: Baclofen is a gamma-aminobutyric acid (GABA) agonist used as a muscle relaxant in the treatment of spasticity. Baclofen is occasionally necessary to continue during pregnancy due to preexisting neurological conditions. Neonatal abstinence syndrome (NAS) including seizures in a benzodiazepine-refractory case has been reported with baclofen and additional information regarding optimal treatment is needed.
Hypothesis: The administration of a baclofen taper shortly after birth will help prevent NAS from intrauterine baclofen exposure.
Methods: A single-patient chart review and review of the literature regarding baclofen exposure during pregnancy and NAS was performed. A 43-year-old female with history of spasticity secondary to a spinal cord injury gave birth to a healthy full-term infant male via spontaneous vaginal delivery. Throughout pregnancy, the mother had received oral baclofen 80 mg daily. In order to mitigate NAS, a baclofen taper was planned after a multidisciplinary meeting. The initial dose was 0.1 mg/kg/day for 4 days, followed by a daily decrease of 0.01 mg/kg/day until discontinuation of the baclofen on the 13th day of life. Daily assessment for NAS was performed using the modified Finnegan NAS scoring system.

Results: Eighty-two modified Finnegan NAS scores were obtained in the first 16 days of life with a mean score of 2.0±2.4. A max NAS score of 9 was observed on the 13th day of life. At no point were there three consecutive NAS scores ≥8, indicating no need for further pharmacological intervention. The infant was discharged 3 days after the taper ended.
Discussion: This study demonstrates the absence of NAS in an infant who received a baclofen taper after intrauterine baclofen exposure from a mother taking 80 mg/day. In addition to the taper, the baby received baclofen through breast milk as well. In fact, baclofen concentrations in milk ranged from 0.28 to 0.38 μg/mL which provided an additional approximate dose of 0.02 mg/kg/day (1/3 diet breast milk).
Conclusion: The administration of a baclofen taper can prevent NAS in the setting of intrauterine baclofen exposure.

54. Baclofen Distribution into Breast Milk—A Potential for Toxicity?

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Background: Baclofen is a gamma-aminobutyric acid (GABA) agonist used as a muscle relaxant in the treatment of spasticity. Baclofen may be used by pregnant and lactating patients but may cause serious toxicity in infants. Other than one case report, there is little data regarding distribution of baclofen into breast milk.
Hypothesis: Nursing infants may be exposed to clinically significant amounts of baclofen when the mother is on oral baclofen.
Methods: A single-patient chart review was conducted. A 43-year-old female with spasticity secondary to a spinal cord injury began supplying breast milk for her baby shortly after giving birth to a healthy full-term infant male. During and after pregnancy, the mother received oral baclofen, 20 mg QID at evenly spaced intervals, between 0600 and 2200 daily. For three consecutive days, breast milk samples were collected at estimated trough (0530) and peak (2400) times. Using high-performance liquid chromatography and tandem mass spectrometry, baclofen concentrations were determined for each sample.
Results: Baclofen mean trough levels were 0.297±0.021 μg/mL and mean peak levels were 0.343±0.033 μg/mL (Table 1).
Discussion: Our patient was taking 80 mg of oral baclofen (20 mg QID) daily and had breast milk concentrations ranging from 0.28 to 0.38 μg/mL. A 3 kg infant consuming 750 mL of breast milk per day would be ingesting approximately 0.075 mg/kg/day, approximately 1/4th the weight-based dose of baclofen (0.29 mg/kg/day) in an average 70 kg adult consuming 20 mg baclofen daily. Infants, however, may have longer elimination half-lives and accumulate baclofen at greater concentrations. Infants may also be more sensitive to the effects of baclofen and exposure to lower amounts of baclofen over time could cause significant toxicity. In our infant-mother pair, the breast milk was initially limited to 1/3 amount of total daily diet (2/3 formula), only after observing for clinical effects and obtaining levels in milk did we increase the ratio to 50 %.
Conclusion: This report adds to the data on baclofen distribution in breast milk. Nursing mothers may have to limit amount of breast milk intake as distribution may be significant.
Table Abstract 54: Baclofen levels

	Day 1	Day 2	Day 3	Mean±SD
Trough level (μg/mL)	0.32	0.29	0.28	0.297±0.021
Peak level (μg/mL)	0.38	0.32	0.33	0.343±0.033

55. Aspirin-Associated Fanconi Syndrome: Is it an Occult Phenomenon?

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Background: Fanconi syndrome is a generalized transport defect within the proximal renal tubules which leads to inappropriate urinary losses of glucose, amino acids, bicarbonate, uric acid, phosphate, potassium, and other organic compounds. It may be inherited or acquired following exposure to certain xenobiotics. The medical literature has a few case reports of aspirin (ASA) intoxication leading to its development.
Research question: In cases of ASA toxicity, what proportion of patients develop laboratory findings consistent with Fanconi syndrome?
Methods: This is a retrospective review at a tertiary care hospital in an urban setting. All cases from 2001 to 2011 with ASA concentrations >30 mg/dL were reviewed for proximal tubule renal dysfunction (either elevation of creatinine on presentation that resolved prior to discharge or development of an elevation during hospital stay), an associated glucosuria (within the renal threshold level of 160–180 mg/dL or greater than expected based on serum glucose levels), and proteinuria.
Results: One hundred three patients in 108 independent encounters had ASA levels >30 mg/dL and were analyzed for elevations in creatinine, proteinuria, and glucosuria. Nine cases were identified to meet the study criteria. The average age was 25.8±9.9 years. Women accounted for 66.7 % of all identified cases. Mean ASA concentration was 59.8±20.4 mg/dL. The mean maximum serum glucose was 142.6±30.1 mg/dL, while the mean maximum urinary glucose was 237.5±174.7 mg/dL. Mean proteinuria was 128.6±75.6 mg/dL, while mean pH was 7.4±1.1.
Discussion: A proposed mechanism for Fanconi syndrome involves covalent bonding of salicylate or its metabolites to the mitochondria of the proximal tubular cells, altering its function and leading to energy-dependent dysfunction of active transporters. Though the study was limited by the retrospective design, restriction to a single center and a small number of events fitting the definition of Fanconi syndrome, the findings consistent with Fanconi syndrome in patients with ASA overdoses suggests ASA's role in the development of renal tubular dysfunction.
Conclusion: Fanconi syndrome was found in 8.7 % of patients, but further studies in a larger scale may provide better understanding regarding the frequency or risk factors for the development of this syndrome following ASA overdose.

56. Transient Fanconi Syndrome Following Salicylate Overdose

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Background: Fanconi syndrome is a generalized transport defect within the proximal renal tubules leading to inappropriate urinary losses of glucose, amino acids, bicarbonate, uric acid, phosphate, potassium, and other organic compounds. It may be inherited or acquired following exposure to certain xenobiotics.
Hypothesis: We hypothesized that salicylates may lead to Fanconi syndrome.
Methods: This is a single-patient chart review. A 15-year-old previously healthy female reportedly ingested 65 g of aspirin in a self-harm attempt. Within 5 h, she experienced nausea, vomiting, abdominal pain, and decreased hearing. Her initial vital signs were a heart rate of 118 beats per minute, respiratory rate of 20 breaths per minute, blood pressure of 137/93 mmHg, and a temperature of 36.1 °C. She was empirically started on an infusion of 5 % dextrose containing 150 mEq of sodium bicarbonate at 200 mL/h. Activated charcoal was also given. Initial laboratory values included: creatinine-1.06 mg/dL, potassium-3.3 mmol/L, bicarbonate-21 mmol/L, a pH of 7.47, and an initial salicylate concentration of 72 mg/dL. Over the next 3 days, she developed acute renal failure.
Results: Creatinine peaked at a level of 1.21 mg/dL. Her urinalysis was notable for elevated protein at 100 mg/dK, glucose was greater than 500 mg/dL despite normal serum glucose concentrations, rising urinary pH and the presence of red blood cells.
Discussion: There is limited data on the role of salicylate intoxication as a cause of proximal tubular dysfunction in humans and it is not previously

described in the toxicology literature. Salicylate effects on renal function are ill-defined, but in large exposure, salicylate may lead to a reversible, generalized, tubular dysfunction and acute tubular necrosis. Proposed mechanisms involve the covalent bonding of salicylate or its metabolites to the mitochondria of the proximal tubular cells, altering function and causing dysfunction of the active transporters. In this case, there was no alternative explanation for the etiology of this transient Fanconi syndrome other than the salicylate exposure.
Conclusion: We present a case of transient Fanconi syndrome following a significant aspirin overdose. Further studies may provide better understanding regarding the frequency or risk factors for its development following salicylate overdose.

57. Twittering Toxicology: Use of MicroBlog for Asynchronous Teaching of Toxicology to Emergency Medicine Residents

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Background: Learning toxicology is an asynchronous process. Clinically severe or novel toxicities are infrequent. The expected breadth of knowledge in toxicology for emergency medicine (EM) residents is much larger than what is typically experienced during a residency. When medical toxicologists are available faculty, they are not ubiquitously available to reinforce salient learning points. In order to more uniformly teach toxicology, we used the social media platform Twitter to broaden our reach and accessibility. We attempt to measure the effectiveness of social media as a teaching tool among a select group of EM residents.
Methods: This is an observational study of three EM toxicologists and seven EM residents from two EM residency programs. We used qualitative descriptions of teaching content and a pre- and post-intervention survey during a 5-month period.
Results: EM toxicologists posted an average of 25 separate topics per month. Residents posted about two questions or replies per month. At the onset, all residents were using social media for personal purposes. The few (3/7) that were using any social media for education were viewing context less than once per day. By the conclusion, the majority (5/6) residents were using social media for educational purposes; half daily. Content felt to be most "useful" were "teaching pearls" (5/6), followed by "clinical cases" (4/6) and "news" (4/6). Barriers to use included content ("my questions are so base… it's way easier to just google it"), unfamiliarity or distrust ("I'm resistant… to social media"), and lack of routine use ("I'm not used to opening up Twitter like I am with opening my gmail").
Conclusions: Our small study suggests that social media can be used as an educational platform for residency education, but for a selected group of learners. Once using Twitter for education, our residents generally continued to use it. We also observe that our group of residents preferred to be passive consumers of educational content. Self-described barriers to use included content level and ease of use of the platform.

58. Trends in Opioid Prescribing Based on Provider Specialty in US Ambulatory Clinics

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Background: In recent years, there have been significant increases in opioid analgesic (OA) prescribing. Trends in opioid prescribing based on the specialty of the care provider are less well characterized.
Research question: This study aims assess trends in OA prescribing by different health care provider specialties in US ambulatory clinics (ACs).
Methods: A retrospective review of data from the Centers for Disease Control and Prevention's National Ambulatory Medical Care Survey (NAMCS) 2006–2010 was performed. All AC visits that were potentially pain-related were included. Trends in AC prescribing of all opioids categorized by provider specialty were evaluated. The proportion of visits during which an OA was prescribed was tabulated and trends were analyzed using survey-weighted logistic regression.
Results: The weighted estimate of pain-related AC visits increased from 148.6 million in 2006 to 173.4 million in 2010 and the proportion of pain-related visits during which an OA was prescribed by any provider specialty did not increase significantly (10.4 to 11.6 %), $p=0.277$. Overall opioid prescribing for pain-related visits was the greatest for family medicine visits (13.7 %). There was considerable variation within individual specialties during the study period, but no statistically significant trends over time between 2006 and 2010 were identified (Table).
Discussion: Trends in overall opioid prescribing did not significantly change for pain-related visits in ACs from 2006 to 2010. These findings suggest that more acute visits, such as in emergency departments, or following inpatient hospitalizations may be major contributors to the increased rates of opioid prescribing in the USA. Our study was limited in that there was not adequate data to evaluate all specialties and small sample size for some specialties in certain years may have contributed to increased variability in the data.
Conclusion: Opioid prescribing in ACs across several US specialties did not change significantly from 2006 to 2010.

Table (Abstract 58). Percent of pain-related visits during which an opioid was prescribed by specialty

Specialty	2006	2007	2008	2009	2010	Relative change	*p* value (trend)
Family Medicine	12.1 %	13.9 %	12.5 %	14.7 %	15.5 %	27.8 %	0.069
Other Specialties	8.9 %	14.8 %	13.9 %	17.5 %	12.2 %	36.9 %	0.190
Internal Medicine	13.5 %	9.9 %	15.1 %	9.2 %	11.2 %	-17.0 %	0.466
Orthopedic Surgery	8.6 %	5.2 %	6.4 %	9.7 %	9.7 %	12.1 %	0.424
Neurology	9.6 %	14.1 %	13.0 %	14.7 %	14.7 %	54.0 %	0.424
General Surgery	7.9 %	10.4 %	3.3 %	1.8 %	11.8 %	49.2 %	0.413

59. Symptoms and Exposure Histories of Chronically Ill Gulf War Veterans Presenting to a Medical Toxicology Clinic After 20 Years

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Background: Approximately 30 % of the US veterans serving in the 1991 Gulf War developed a chronic illness that persists 20 years after the conflict that has been resistant to treatment.
Objective: This study aims to report the symptom profile on presentation and exposure histories of ill Gulf War Veterans evaluated by a medical toxicology clinic for an ongoing treatment protocol.

Methods: A modified Kansas case definition of Gulf War Illness was used to screen veterans of the 1991 Gulf War. Veterans were contacted through veterans organizations, web postings, and mailings from a Department of Defense manpower database. After informed consent, a screening telephone interview, was conducted. Veterans meeting inclusion criteria were scheduled for an initial clinic visit at a medical toxicology clinic. A standardized history and physical examination was performed, an exposure history was taken, and symptoms were scored using a visual analogue scale. Other data obtained but not reported here included completion of the SF-36 health assessment questionnaire and the Connors Continuous Performance test. Means+standard errors of visual analogue scores were calculated.
Results: Forty-two 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. Visual analogue scores are given in the table. The only consistent finding on physical examination was rhinitis (100 %). Treatment histories included a variety of psychotropic, analgesic, and antiflammatory medications which were reportedly not helpful. Reported exposure histories were oral pyridostigmine bromide (95 %), vaccines including anthrax (88 %), SCUD missile attacks with chemical alarms sounding (76 %), smoke from oil well fires (69 %), and pesticide sprays in living spaces (50 %). Seven percent reported exposure to depleted uranium. Four percent% reported being in the vicinity of the demolition of the sarin ammunition site at Khamsieh. Three percent reported being in the vicinity of other ammunition sites.
Conclusion: Twenty years after the 1991 Gulf War, chronically ill veterans presented to a medical toxicology clinic with a consistent illness consisting of chronic fatigue, chronic pain, and neuropsychological disabilities. Exposures to cholinesterase inhibitors and smoke from oil well fires were reported.
Table (Abstract 59).

Symptom	Visual analogue score 10 cm scale (mean±standard deviation in cm)
Sleep disturbance	71.8±4.3
Fatigue	65.4±5.0
Arthralgias	61.0±4.9
Myalgias	59.6±4.9
Irritability	52.3±5.0
Difficulty with memory	53.1±4.2
Headaches	51.1±4.9
Difficulty concentrating	46.7±4.8
Inappropriate anger	44.3±5.1

60. Volume of Vodka Absorbed in Commercially Available Tampons

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Background: Ethanol use is commonplace amongst adolescents and young adults. Much attention in the popular press is given to "recent phenomenon" of this group utilizing "tampons soaked in vodka" as a clandestine means for ethanol intoxication either vaginally or rectally. Whilst concerning, it is unclear if ethanol intoxication could be achieved through this technique.
Research question: How much volume of ethanol can standard tampons absorb utilizing vodka?
Methods: Four different types of commercially available tampons were purchased—Tampax® regular (A), super absorbent (B), Kotex® regular (C), and super absorbent (D). Standard 80 proof (40 %) 250 ml vodka was measured with graduated cylinder. Each tampon was submerged separately in 250 mL of vodka in a beaker for 10 min each using stopwatch whilst still in the applicator. After 10 min, the tampon was removed and the volume remaining in beaker was measured with graduated cylinder calibrated to 1 mL increments. Each tampon type underwent three separate experiments, i.e. triplicate. The mean volume and standard deviation of each type were calculated. In addition, a separate tampon of each type was removed from the applicator and placed in 250 mL vodka and the volume absorbed was measured after 10 min. This was done once per each tampon.
Results: The Tampax® A group absorbed 9±1 mL, Tampax® B group absorbed 7±2 mL, Kotex® C group absorbed 11±1.5 mL, and Kotex® D group absorbed 10±5 mL. The maximum absorbed by any of type was 15 mL in one of Kotex® D group. Without applicator, the amount absorbed was 31, 30, 25, and 29 mL in groups A, B, C, and D, respectively.
Discussion: Our results demonstrate that minimal amounts of vodka are absorbed following submersion for 10 min of intact tampons in applicators. The amount of vodka did increase to approximately 30 mL without applicator; however, physical inspection of the expanded tampons suggests it would be difficult if not impossible to successfully insert the expanded tampons outside of the applicator. Attempts would likely extrude a considerable amount of the ethanol.
Conclusion: Our data suggests that minimal amounts of vodka are absorbed by various types of tampons and clinical intoxication would be unlikely if applied from intact applicators.

61. Severe Bark Scorpion Envenomation in Adults

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Background: AAPCC data indicates there were 19,108 calls in 2011 regarding scorpion envenomation with the vast majority involving adults. The threat of scorpion envenomation to pediatric patients is well known. However, little information is available regarding adults with severe scorpion envenomation.
Research Question: Are adults with severe envenomation from *Centruroides sculpturatus* at risk for significant morbidity?
Methods: This is a retrospective study of adults (age, >18 years) presenting to a tertiary referral center with severe scorpion envenomation from January 1, 2007 thru March 3, 2013. Patients were identified by a search of the hospital's electronic medical records for encounters containing ICD-9 code family "venomous animals and plants as the cause of poisoning and toxic reactions". Patients with grades III or IV envenomation for which medical records were available were included in the study. Descriptive statistical analysis was performed.
Results: Thirty patients met inclusion criteria, 60 % were female (18/30), average age was 38.6 (20–81) years, and average time to healthcare facility was 134.3 (14–720) min. Signs and symptoms are summarized (Table). Average length of stay was 27.7 (1.5–307) h with 53 % (16/30) requiring hospital admission. Two patients developed rhabdomyolysis (CK >500 IU/L). Two patients were pregnant with one requiring admission and fetal monitoring; both had good outcomes. Two patients required cardiac evaluation due to elevated troponin, chest pain, and pre-existing CAD. Two patients required intubation due to iatrogenic sedation. One had respiratory failure due to a medication error that occurred after signs of envenomation had largely resolved; this patient had evidence of aspiration on CXR. Another patient developed CNS and respiratory depression from titration of opioids and benzodiazepines necessitating two doses of naloxone and ICU transfer. The most frequently used symptom control agents were benzodiazepines 87 % (26/30) and opioids 83 % (25/30).

Discussion: Adults with severe scorpion envenomation often require overnight admission to control symptoms or to manage side effects of treatment. These patients may be at risk for medical errors.
Conclusion: Little information is available in the medical literature regarding adults with severe scorpion envenomation. This study suggests that this population may be at risk for significant morbidity.

Table (Abstract 61). Severe Bark Scorpion Envenomation in Adults

Sign or symptom of envenomation	*n*	%
Pain/paresthesias	28	93
Opsoclonus	24	80
Excessive motor activity	22	73
Visual disturbance	22	73
Hypertension (SBP >140 or DBP >90 mmHg)	13	43
Difficulty ambulating	12	40
Hypersalivation	11	37
Tachycardia (HR >100 bpm)	10	33
Vomiting	4	13

62. Medical Toxicologist Practice Patterns and Attitudes Toward Compensation

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Background: Medical toxicology (MT) is a relatively new specialty. Little is known regarding MT practice patterns, financial compensation, or attitudes regarding compensation.
Research question: Our aim was to survey and describe the opinions of MTs regarding their practice patterns and compensation.
Methods: The ACMT practice committee conducted an anonymous, electronic survey of ACMT members regarding their practice patterns, compensation, and salaries. Survey invitations were sent out by e-mail to all ACMT members in December 2012. Reminder e-mails were sent in January and February 2013. Blinded results were analyzed using simple statistics.
Results: There were 176 total respondents which represented a 49 % (176/360) response rate. The most common primary specialties were emergency medicine (81 %, 139/171), pediatrics (10 %, 17/171), and internal medicine (7 %, 12/171). The majority of the respondents (86 %, 150/175) completed MT fellowship. Of practicing MTs, 78 % identify themselves as working in academia, 64 % in clinical practice, and 58 % with a poison control center (PCC). The majority (59 %) of MTs surveyed report spending less than half of their time on MT activities and one third (31 %, 49/155) spend less than 25 % of their time on MT activities. Only 16 % (25/155) report practicing full time. Seven percent (11/150) of surveyed toxicologists receive full-time compensation from PCCs. Thirty-three percent (49/150) provide free work to a PCCs. Forty-six percent (68/149) of MTs do not feel that they are fairly compensated for their work. Fifty-four percent (85/157) would like to expand their toxicology activities. However, 87 % (137/158) believe that significant barriers to expansion exist.
Discussion: Academia and PCC work are still the most common practice scenarios for MTs. Full-time MT practice is unusual. The majority of MTs spend less than half their professional time on toxicology-related activities. PCC work is common among MTs; full-time employment is unusual. Many MTs do not feel they are fairly compensated for toxicology work. Over half would like to expand their toxicology practice but the majority perceives significant barriers to expansion.
Conclusion: Full-time practice is unusual in MT. PCC work is common, but full-time compensation is not. Many MTs do not feel that they are fairly compensated.

63. Non-APAP Containing Xenobiotics Associated with AST >1,000 U/L

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Background: Acetaminophen (APAP) commonly causes elevations in AST >1,000 U/L. The next most commonly implicated xenobiotics causing AST >1,000 are less clear.
Research question: What is the prevalence of non-APAP containing xenobiotics associated with AST >1,000 seen by medical toxicologists?
Methods: Using the search criteria "AST >1,000", all cases entered into the Toxicology Investigators Consortium (ToxIC) database from May 1, 2012 to October 30, 2013 were reviewed. Four hundred sixty-two cases met these criteria. Two hundred sixty-three cases with an APAP-containing xenobiotic as primary or secondary agent of exposure were excluded. Sixty-four cases where a xenobiotic was not specified, and another five cases that were deemed "unlikely tox related" were also excluded. Of the remaining 130 cases, there were 95 single-agent exposures and 35 multi-agent exposures. We limited our analysis to single-agent exposures for the prevalence of different xenobiotics and the clinical outcomes.
Results: Ethanol was the primary xenobiotic in 52/95 (55 %) cases. Of these, 14 (27 %) developed metabolic acidosis (pH<7.2), 8 (15.3 %) developed hyperreflexia, myoclonus or clonus, 5 (9.6 %) developed acute kidney injury (AKI) (creatinine >2), and 3 (5.7 %) died. Opioids accounted for 9/95 (9 %) cases. AKI occurred in seven (78 %) opioid cases, rhabdomyolysis (CPK >1,000) in five (55 %), and death in two (22 %). Methamphetamine exposures comprised 7/95 (7 %) cases. Four (57 %) developed AKI and five (71 %) developed rhabdomyolysis. Mortality among this group was 14 %. Overall mortality among all single-agent non-APAP cases analyzed was 9 %. Other agents associated with death included rivaroxaban and valproic acid. Synthetic cathinones, carbamazepine, carisoprodol, acetazolamide, methimazole, risperidol, and black cohash were also associated with AST >1,000.
Discussion: Ethanol was commonly associated with AST >1,000 in this series although this is not typical of ethanol-induced liver injury. The high prevalence AKI in the opioid and methamphetamine patients suggested development of multisystem failure. Prospective studies on patients with AST >1,000 would better characterize the mechanisms of these liver injuries.
Conclusion: Frequently abused xenobiotics including ethanol, opioids, and methamphetamine accounted for the most non-APAP associated AST >1,000 cases seen by medical toxicologists.

64. Neuropsychiatric Events Associated with Mefloquine Reported to a Poison Center Network

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Introduction: In July 2013, the FDA issued a black box warning for mefloquine relating to acute neuropsychiatric events (NSEs). Numerous case reports exist pertaining to neuropsychiatric events in the literature; however, our literature review did not find any larger case series.

Hypothesis: The prevalence of NSEs among patients reporting adverse events (AEs) related to mefloquine is low and that the most common AE would be the very nonspecific "headache."
Methods: Using the search term "mefloquine", all cases entered into the Texas Poison Center Network (TPCN) database from January 1, 2000 to June 1, 2013 were reviewed. The codes for all AEs were assessed. The individual charts for all cases that included a code for NSEs were reviewed in detail. Patients with coingestions were included.
Results: Fifty-six mefloquine cases were identified. Fifty-two percent were male. The ages: 55 % were ≥20, 12.5 % were 6–9, and 30.4 % were 0–5. The most common symptoms were all gastrointestinal, nausea (10.7 %), diarrhea (8.9 %), and abdominal pain (7.1 %). Neuropsychiatric symptoms were identified in nine (16 %) cases, all were single agent exposures. Among the nine cases, dizziness occurred in five, confusion in three, headache in two, agitation in two, and visual hallucinations in one. The number of tablets ingested ranged from 1 to 7. The duration of exposures ranged from a single one to the pills taken over 1 week. Medication dosing errors occurred in four of these nine cases because the patients took the medication daily instead of weekly.
Discussion: While the most common AEs associated with mefloquine were gastrointestinal, the neuropsychiatric symptoms were more commonly reported than what we expected. Also, the symptoms included confusion and hallucinations. Headache, while present, was not very common. Interestingly, 4/9 patients with NSEs had mistakenly taken the medicine daily vs. the prescribed weekly regimen, reflecting the ease in which this medicine can be taken inappropriately.
Conclusion: Mefloquine-related neuropsychiatric symptoms occurred in 16 % of the reported cases and the most common NSE was dizziness.

65. A Comparative Study of Acetaminophen Exposures in ToxIC Registry with Texas Poison Center Data

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Background: Acetaminophen (APAP) exposures are common in toxicology. The data from these exposures have been traditionally registered in the National Poison Data System (NPDS). This database has been the main source of epidemiological information about toxicological problems. However, in 2010, the American College of Medical Toxicology (ACMT) created the Toxicologic Investigators Consortium (ToxIC) in order to register cases seen by medical toxicologists (MT) at the bedside.
Study question: Do APAP cases reported in the ToxIC registry have more serious clinical presentations than those in the NPDS?
Methods: This is a comparative study of demographic and clinical data of acetaminophen exposures in the ToxIC registry with the Texas Poison Center Network (TPCN) database from January 1, 2010 to October 30, 2013. While not all of the data from the TPCN database are downloaded into NPDS, much is, and it thus reflects the total NPDS to a reasonable degree. The clinical information analyzed included all cases with hepatotoxicity, coagulopathy, acute kidney injury, liver function test abnormalities, hepatic necrosis, and hepatitis.
Results: In the ToxIC registry, we identified 2,787 (11 %) acetaminophen cases from 24,609 total exposures vs 44,241 acetaminophen cases (7 %) from 640,946 total exposures in TPCN database. Twenty-two percent of the acetaminophen cases in the ToxIC registry had hepatotoxicity vs 2 % in the TPCN database. NAC was administered in 69 % of ToxIC patients vs 17 % in TPCN. The table has other comparisons.
Discussion: Hepatotoxicity, coagulopathy, and acute renal injury were more commonly seen in ToxIC registry than TPCN cases and NAC was more frequently given in the ToxIC registry than TPCN database. A limitation is differences in coding between these two databases.
Conclusion: APAP-exposed patients in the ToxIC registry are more severely poisoned than those in the TPCN database.
Table (Abstract 65).

Database	ToxIC (%)	TPCN (%)
Age 19–65 years	67	43
Female	66	58
Intentional ingestion	75	47
Coagulopathy	10	1
Acute kidney injury	7	0.7

66. Carbon Dioxide Associated Poisoning Fatalities in the USA from 2000 to 2011

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Background: Carbon dioxide is a colorless, odorless gas with poor warning properties. Deaths from exposure are probably uncommon, but there are numerous reports in the literature and media. There has been no attempt to identify these cases systematically to assess the burden of mortality from carbon dioxide poisoning in the USA. This is likely difficult to do because of diverse reporting mechanisms.
Research question: What is the incidence of carbon dioxide associated fatalities in the USA between January 1, 2000 and December 31, 2011?
Methods: This is a retrospective review of multiple databases to identify fatalities associated with carbon dioxide from 2000 to 2011. We will manually review the annual reports from the National Poison Data System (NPDS) using defined search criteria. We will search PubMed and Web of Science for cases published in the literature, search the LexisNexis database for print news articles, and search the National Electronic Injury Surveillance System (NEISS). All results will be reviewed by a medical toxicologist for duplicate or improperly classified cases.
Results: We identified 5 deaths in NPDS, 6 deaths in the literature, 124 in news articles, and 0 deaths in NEISS. Three deaths from the literature search were excluded because of improper classification. There were 124 news articles; however, many described the same case or actually referred to carbon monoxide instead; excluding these left 16 fatalities. Of these 16, 2 described cases reported in NPDS and 1 was from the literature search. Reported ages of the 21 total unique cases ranged from 19 to 80 years, and included an extremely wide range of circumstances ranging from a fast-food restaurant bathroom carbon dioxide leak to being locked in a room when the carbon dioxide-based fire suppression system was triggered. Sixteen deaths (69.5 %) were unintentional and 12 (52 %) were occupational. Five incidents involved multiple deaths.
Discussion: The news media database yielded the most cases, many of which were not reported in other databases. Many deaths were unintentional and occurred at work.
Conclusion: We identified 21 unique cases of carbon dioxide-associated fatalities in the USA in an 11-year time period with a very diverse situation for nearly every fatality.

67. An Atypical Presentation of a Tricyclic Antidepressant Overdose Due to a Bezoar

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Background: Tricyclic antidepressants cause predominantly cardiovascular and neurologic toxicity. Onset of symptoms is rapid in overdose and is often seen within the first 1–2 h.

Hypothesis: Pill bezoars can significantly alter onset and peak symptoms in overdose.
Methods: A 53-year-old male with a history of hypertension and diabetes presented to the emergency department (ED) with altered mental status. The patient's sister at bedside said that his regular medications included metformin, glyburide, aspirin, prasurgrel, and metoprolol. The patient had several episodes of emesis the night prior, but was otherwise normal. His wife tried to wake him in the morning and noted that he was confused, with slurred speech, so she called emergency medical services and he was brought to the ED around 1000 hours. The initial electrocardiogram (ECG) showed sinus tachycardia with a rate of 118 bpm, QRS of 116 ms with no tall R wave in aVr. There were no prior ECGs for comparison. A sodium bicarbonate bolus was given without change in the QRS duration. The patient became more obtunded and was intubated at 1600 hours. He had a generalized tonic-clonic seizure at 1630 hours despite optimal ventilation. The patient received a CT scan of his abdomen which revealed a large amount of hyperdense material resembling pills in his stomach. The patient continued to have a prolonged QRS (peak of 138 ms) and was therefore started on sodium bicarbonate therapy. Gastroenterology was consulted for an EGD to extract the pills. He was treated with activated charcoal and whole bowel irrigation after the EGD to limit toxicity of the remaining pills.
Results: Urine GC/MS and whole pill identification was positive for clomipramine. His tachycardia gradually improved, as did his QRS, which was <100 ms on hospital day #9.
Discussion: Tricyclic antidepressants are one of the few drugs where we have both pharmacokinetic and toxicokinetic data. However, this case illustrates a clinical scenario where toxicokinetic data did not predict the clinical course.
Conclusion: Pill bezoars can cause a delay in onset of significant toxicity after tricyclic antidepressant overdose, as well as prolonged toxicity.

68. Cobalt, Cardiomyopathy, and Chelation in a Patient with a Metal-on-Metal Hip Implant

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Background: Certain metal-on-metal (MoM) hip prostheses have been associated with increased wear and deterioration resulting in chronic cobalt exposure. There have been reports of elevated cobalt concentrations and early prosthesis failure in patients with MoM implants, however, systemic cobalt toxicity is rare in this setting.
Hypothesis: Chronic cobalt exposure from MoM prostheses can result in non-ischemic cardiomyopathy.
Methods: This is a single-patient chart review. A 63-year-old man with a prior history of deep vein thrombosis, peptic ulcer disease, hypertension, and dyslipidemia underwent a total hip athroplasty, receiving MoM prosthesis. Three years later, he was admitted to the hospital with decompensated heart failure with an ejection fraction of 10–15 %. During the previous year, the patient had progressive shortness of breath and exercise intolerance and was diagnosed with non-ischemic cardiomyopathy after an extensive work-up, including cardiac catheterization and biopsy. Cobalt concentrations were obtained given the history of MoM prosthesis.
Results: The peak measured urine cobalt concentration was 202 μg/L (reference range, 0.1–2 μg/L) and was felt to be contributory to the development of the patient's cardiomyopathy. The patient also had a urine chromium concentration of 57.6 μg/L (reference range, 0–10 μg/L). Orthopedics was consulted for potential removal of the prosthesis, but the patient had developed renal failure and *Staphylococcus aureus* sepsis and was not stable for surgery. The patient underwent chelation therapy with succimer, which decreased his measured urine cobalt concentration to 11 μg/L. Subsequently he developed an arterial thrombus in the lower extremity, which required operative removal and fasciotomy. He was placed on extracorporeal membrane oxygenation due to hemodynamic instability. The patient had a biventricular assist device placed, but ultimately expired.
Discussion: Although this patient was treated with succimer and urine cobalt concentrations were successfully reduced, there was no improvement in the patient's clinical condition. Clinical recovery may not have been possible, as many of the pathophysiologic manifestation of cobaltism are often irreversible.
Conclusion: Systemic toxicity, including cardiomyopathy may occur pursuant to chronic cobalt exposure from MoM prosthesis.

69. The ToxIC North American Snakebite Registry

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Background: Snakebite affects thousands of people in the USA annually and can cause significant morbidity and mortality. Despite the large impact on victims, current understanding of venom pathophysiology, predictors of severity, treatment strategies, and long-term outcome is limited. The Toxicology Investigators Consortium (ToxIC) North American Snakebite Registry (NASBR) was established to collect de-identified data regarding all aspects of snake envenomation.
Research question: Can the NASBR serve as a research tool to collect a large amount of data from multiple toxicology centers across the USA?
Methods: Data reported to the NASBR between March 1 and October 24, 2013 were reviewed. Results are reported using descriptive statistics.
Results: Eight sites representing seven states across the USA contributed 96 cases. One non-native bite was excluded. Of 95 subjects, 72 % were men. Sixty-nine percent 69 % were age 13–65 years old, 9 % <13 years old, and 12 % >65 years. Forty percent had co-morbidities. Six percent had acute ethanol exposure. Bites were from 61 rattlesnakes, 22 copperheads, 2 cottonmouths, and 10 unknown crotalids. Forty-five percent were upper extremity and 55 % lower extremity bites. Ninety-three percent demonstrated swelling and 35 % erythema, 9 % received prophylactic or empiric antibiotics. Thirty-nine percent had hemotoxicity, 4 had minor early bleeding. Fifteen percent had bullae or necrosis. Five percent had neurotoxicity. Six patients had a tourniquet placed. Eighty-four percent received antivenom. Six patients received prophylaxis against antivenom reaction. Seven (9 %) adverse reactions to antivenom were reported. Six procedures were performed, including four wound debridements and two fasciotomies. Thirty-nine percent of the patients had at least one set of follow-up labs. One patient was readmitted 2 days post-bite for worsening thrombocytopenia and bleeding. Three additional patients were admitted 4–7 days post-bite, all with late thrombocytopenia and two with complete defibrination. One was admitted a third time 15 days post-bite for a second thrombocytopenia recurrence.
Discussion: These data provide a nationally representative sample of snakebite victims seen at the bedside by medical toxicologists. The registry provides a unique opportunity to study numerous aspects of snake envenomation, including at-risk populations, rare effects, unusual treatments, and relationship between patient factors, severity, and outcomes.
Conclusion: The NASBR is a powerful tool for gathering and studying a vast amount of information related to snakebite.
***On behalf the ToxIC Snakebite Study (TICSS) group:** Anna Arroyo-Plascencia, Vikhyat S. Bebarta, Michael Beuhler, Adam Bosak, Jeffrey Brent, Daniel Brooks, E. Martin Caravati, Steven Curry, William Dribben, Kimberlie Graeme, S. Eliza Halcomb, C. William Heise, Janetta Iwanicki, William Kerns II, Thomas Kibby, Kurt Kleinschmidt, Michael Levine, Rachel Levitan, Frank LoVecchio, Michael E. Mullins, Ayrn

O'Connor, Angie Padilla-Jones, Anne-Michelle Ruha, Evan S. Schwarz, Aaron Skolnik, Eric Smith, An Tran, Shawn M. Varney, Rais Vohra, Paul Wax

70. Incidence of Retained Foreign Body Following a Snakebite

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Introduction: Snakebites are a common complaint of emergency department visitors. From 2008 to 2010, there were 19,746 human exposures to venomous snakes in the USA and in 2011 alone, there were 6,630 snakebite cases reported to the American Association of Poison Control Centers. Review of the literature demonstrates only a few cases of an embedded snake foreign body (FB). However, in addition to standard treatment, numerous reputable sources for healthcare providers advocate for routine imaging to rule out a snake foreign body.
Methodology: A Toxicall database at a regional poison center serving a population of 2.8 million people was queried for all records indicating a snakebite from January 2003 through June 2013. Results were then searched using the free-text section in the notes field for the following terms: "fang", "tooth", "teeth", "x-ray", "xray", and "x ray". As a snake tooth or fang were anticipated to be the key foreign bodies identified on X-ray imaging, variations of these terms were used in the search criteria. Each chart that had at least one of these terms was independently reviewed for the presence or absence of a foreign body.
Results: The query returned 1,679 charts indicating a snakebite, of which 11 % (n=183) contained one of the aforementioned search terms. Review of these charts did not result in any cases with a retained foreign body.
Conclusion: Snakebites are a common-presenting problem in US emergency departments. Our review found no instances of retained foreign body in snakebites occurring between 2003 and June 2013. Based on the data from this poison center, we propose that snakebites do not require routine imaging to evaluate for retained foreign bodies as this is an exceedingly rare occurrence.

71. Ability of Senior Medical Students to Identify Common Serotonergic Agents When Treating Serotonin Syndrome

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Background: Serotonergic agents have become ubiquitous throughout medical care and include drugs such as selective serotonin reuptake inhibitors (SSRI), monoamine oxidase inhibitors, select opioids (tramadol, fentanyl, and meperidine), antimicrobials (linezolid), over-the-counter preparations (dextromethorphan), lithium, and drugs of abuse (MDMA, LSD, cocaine, mushrooms). Despite the frequent prescribing pattern of serotonergic medications, medical students have often been unable to identify serotonergic medications during their medical toxicology rotation. The object of this study is to determine if senior medical students are cognizant of drugs that have high serotonergic activity and could potentiate serotonin syndrome.
Methods: A clinical vignette regarding an adolescent male who daily takes an SSRI and who presented with fulminant serotonin syndrome after abusing dextromethorphan was distributed to a fourth year medical school class at one institution. Students were given a list of drugs commonly used in the ICU setting and asked to identify which were known to increase serotonergic activity and thus be avoided in the management of this patient. Response to the survey was entirely voluntary and two reminder emails were sent to increase responses.
Results: One hundred twenty participants replied out of a class of 155 for a 77.4 % response rate. The following agents were correctly identified for their potential to increase serotonergic activity: 87.5 % sertraline, 50.8 % meperidine, 35.8 % linezolid, 18.3 % fentanyl, and 16.7 % lithium. The following agents were incorrectly identified as worsening serotonin syndrome: 45 % quetiapine, 12.5 % dexmedetomidine, 5 % propofol, 3.3 % midazolam, and 0 % cefepime.
Discussion: Our results demonstrate significant gaps in understanding of serotonergic agents among fourth year medical students. While 87.5 % were able to identify that sertraline would worsen the syndrome, only 50 % identified meperidine as serotonergic despite the historical implications of this interaction. Also concerning was the belief that quetiapine had serotonin agonist activity reflecting failure to understand the mechanism of this commonly prescribed xenobiotic.
Conclusion: Senior medical students require increased education on the pharmacology of commonly used serotonergic drugs in the ICU setting to avoid worsening serotonin syndrome or causing an iatrogenic adverse drug reaction.

72. Cost-Minimization Analysis of Different Strategies of Management of Clinically Significant Scorpion Envenomation Among Pediatric Patients

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Objective: Recently, an effective antivenom for clinically significant scorpion envenomation has been approved by the Food and Drug Administration (FDA) and is being increasingly used in emergency departments across the country, but no formal economic analysis on its impact on cost of management of these patients has been performed.
Methods: Three different strategies of clinical management of scorpion envenomation with systemic neurotoxic symptoms in pediatric patients were compared for cost minimization from a third-party-payer perspective. In strategy I, patients with clinically significant scorpion envenomation with cranial nerve dysfunction and/or somatic skeletal neuromuscular dysfunction were managed with supportive care only and without use of scorpion antivenom. In strategy II, an aggressive strategy of full-dose Anascorp® antivenom (initial dose of three vials with the use of additional vials administered one vial at a time) was considered. In strategy III, a single-vial serial dosing strategy of Anascorp® titrated to clinical response was considered. Clinical probabilities for the different strategies were obtained from retrospective review of medical records of patients with scorpion envenomation over a 10-year period at our institution and from published information. Baselines cost values were obtained from patient reimbursement data from our institution. Indirect costs were not considered in this analysis.
Results: In the baseline analysis, strategy I of supportive care only with no antivenom was the least costly at $3,466.50 per patient. Strategy III of single-vial serial dosing was intermediate but less expensive than strategy II of full-dose antivenom, with an incremental cost of $3,171.08 per patient. In a one-way sensitivity analysis, at a threshold antivenom cost of $1,577.87, strategy III of single-vial serial dosing became the least costly strategy.
Conclusion: For children with scorpion envenomation with neurotoxic symptoms, use of a management strategy based on serial dosing of Anascorp® titrated to clinical response is less costly than a strategy of initial use of full-dose antivenom. Also, lowering the cost of antivenom would make use of titrated antivenom dosing in all children with significant neurotoxic symptoms the most favored strategy even compared to the strategy of conservative management without use of antivenom.

73. Case Series of Hemolytic Anemia and Thrombotic Thrombocytopenic Purpura Following Intravenous Injection of Reformulated Oxymorphone Hydrochloride Extended Release (Opana ER®)

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Background: Intravenous injection of reformulated Opana ER® has recently been described to cause hemolytic anemia and thrombotic thrombocytopenic purpura (TTP) in a 2012 report by the Tennessee Department of Health. TTP is a relatively rare hematologic condition characterized by microangiopathic hemolytic anemia and widespread activation of the coagulation cascade, leading to coagulopathy, consumption of platelets, and resulting in end-organ damage.
Hypothesis: Intravenous administration of the newest reformulation of Opana ER® (Endo Pharmaceuticals Inc.) has potential to cause hemolytic anemia and TTP.
Methods: This is a chart review of two patients. A 40-year-old female presented to the emergency department with 1 month of progressive, generalized weakness, dyspnea, and jaundice. She admitted to crushing and intravenously injecting Opana ER®. Laboratory studies revealed anemia, thrombocytopenia, acute renal failure, and coagulopathy. Hemolysis was signified by markedly elevated lactate dehydrogenase (LDH) and schistocytes on blood smear. She required 16 sessions of plasmapheresis, high-dose methylprednisolone, and blood transfusions. One month prior, her 46-year-old husband was admitted with 2 weeks of generalized fatigue, nosebleeds, confusion, blurry vision, and dyspnea on exertion. Laboratory studies revealed anemia, thrombocytopenia, elevated troponin, and markedly elevated LDH. Peripheral smear demonstrated helmet cells and schistocytes. He responded to plasmapheresis and was discharged only to be readmitted 3 days prior to his wife for an early relapse of TTP. In total, he required 18 plasma exchanges.
Results: Review of two patient charts reveals diagnoses consistent with hemolytic anemia and TTP. Standard therapy for TTP resulted in eventual normalization of hematologic parameters.
Discussion: Two cases of TTP are described in individuals who admitted to crushing and injecting reformulated Opana ER®. Review of records and history is negative for other known causes of TTP. The mechanism by which this occurred is unknown. Proposed mechanisms include the effects of abuse-preventing inactive ingredients which are found in the newest reformulation. A comparison of inactive ingredients is made (Table). Cases of TTP have not been linked to older formulations of Opana ER® suggesting a mechanism unique to the newest formulation.
Conclusion: Hemolytic anemia and thrombotic thrombocytopenic purpura may occur following the intravenous injection of reformulated Opana ER®.

Table (Abstract 73). Ingredients by formulation

Reformulated Opana ER® (Endo Pharmaceuticals Inc., February 2012)	Opana ER® original formulation (Endo Pharmaceuticals Inc., 2006)	OxyContin® (Purdue Pharma L.P., October 2010)
Active	*Active*	*Active*
Oxymorphone hydrochloride	Oxymorphone hydrochloride	Oxycodone hydrochloride
Inactive	*Inactive*	*Inactive*
Hypromellose	Hypromellose	Butylated hydroxytoluene
INTAC® (polyethylene oxide)	methylparaben	hypromellose
polyethylene glycol	Silicified microcrystalline cellulose	polyethylene glycol 400 polyethylene oxide magnesium stearate titanium dioxide
α-Tocopherol citric acid	Sodium stearyl fumarate	
polyvinyl alcohol	TIMERx® (locust gum and xanthan gum)	
titanium dioxide	titanium dioxide	
macrogol	triacetin	
Talc		

74. Ergotism in Thailand: Drug–Drug Interactions and Factitious Hypotension

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Background: Although uncommon, severe ergotism continues to occur in Thailand. We sought to determine the precipitating factors and clinical manifestations of these cases.
Method: This is a retrospective cohort study of all patients with ergotism consulted to Ramathibodi Poison Center Bangkok, Thailand from January 2006 to August 2013. Cases were identified by substance codes, and data were abstracted by poison center senior scientist.
Result: Twelve cases of ergotism were identified. Patient ages ranged from 15 months to 50 years. Nine patients were female. All cases were associated with ergotamine 1 mg/caffeine 100 mg combination tablets. Nine cases (75 %) were precipitated by drug–drug interactions with CYP 3A4 inhibitors: lopinavir/ritonavir (eight cases) and erythromycin (one case). In none of these cases was overdose suspected. The other cases involved suicidal intent (two cases) and accidental ingestion (one case). Ten patients had vascular insufficiency symptoms including cooling, numbness, pain, and pulse deficit in distal limbs, treated with vasodilators and anticoagulants. Five of these patients initially had low or unmeasurable blood pressure by noninvasive technique which resolved after intravenous vasodilator administration. One patient died from rhabdomyolysis and acute renal failure, two underwent partial foot amputations due to lower extremity gangrene, and seven patients recovered fully. Two patients did not develop vascular insufficiency symptoms. One was a 15-month-old boy with unsupervised ingestion of an unknown dose presented with alteration of consciousness and seizure. He was intubated, treated with diazepam and phenobarbital. He died on the next day. Another case was 14-year-old female who ingested 100 tablets with suicidal intent. She presented with vomiting and recovered with supportive care.
Discussion: Severe ergotism cases continue to occur in Thailand. Most cases are caused by interaction with CYP3A4 inhibitors, which increase ergotamine bioavailability at least fourfold. Factitious low blood pressure in these cases was caused by severe vasospasm. The severe symptom in 15-month-old case may be from poor metabolism of ergotamine and caffeine due to immature of CYP3A4 and 1A2, respectively.
Conclusion: Severe ergotism can be precipitated by drug interaction and present with factitious hypotension caused by profound vasospasm.

75. Management of Supratherapeutic Vancomycin Levels in a 10-Year-Old Child with Acute Renal Failure: A Case Report

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Background: Intravenous (IV) vancomycin is an antibiotic with a narrow therapeutic index and the potential for nephrotoxicity and ototoxicity. Risk factors for toxicity include a prolonged course of treatment (>7 days), elevated trough level (>20 mg/L), and pre-existing renal disease. Vancomycin has a molecular weight of 1,485 Da, a volume of distribution of 0.39 L/kg, is 30 % protein-bound, and is cleared primarily via glomerular filtration.
Case Report: A 10-year-old, 46 kg male with severe eczema was admitted for treatment of cellulitis caused by multidrug-resistant *Staphylococcus aureus*. His initial renal function was normal (BUN/Cr=4/0.6 mg/dL), and he was started on vancomycin 1 g IV every 8 h. The first vancomycin serum trough level was 14 mg/L (therapeutic range, 10–20 mg/L) on hospital day 2. No further monitoring was performed until hospital day 6, when the patient developed vomiting and oliguria. He was found to have acute renal failure with a BUN/Cr 21/3.4 mg/dL and a

random serum vancomycin level of 160 mg/L. No other etiology of his renal injury was identified, although he had received a single dose of ibuprofen on the preceding day. Per the recommendations of the poison center, the patient was transferred to a pediatric tertiary care hospital, where continuous venovenous hemofiltration (CVVH) was performed with an HF 1,200 filter (Medivators, Inc.) at a flow rate of 100 mL/min for 16.5 h. During CVVH, the renal function improved and the vancomycin level declined to 38.9 mg/L. Using a first-order elimination model, the vancomycin half lives were estimated to be 53 h before CVVH and 9 h during CVVH. After hemofiltration, the patient's renal function continued to improve, and he was discharged with outpatient nephrology follow-up.

Conclusion: Supratherapeutic vancomycin levels can lead to acute renal toxicity or can be exacerbated by primary renal injury. The primary mechanism underlying this patient's toxicity is not known. CVVH performed with a large-pore membrane appears to enhance the clearance of vancomycin and decrease its serum elimination half-life.

Table (Abstract 75). Serum creatinine and vancomycin levels during hospital course

	Day 2	Day 6	Day 7			Day 8	Day 13
			CVVH started (03:30 am)	10:25 am	CVVH stopped (18:00 pm)		
Creatinine (mg/dL)	0.6	3.4	3.9	3.0	2.3	3.3	1.2
Vancomycin (mg/L)	14.0	160.0	95.7	66.0	38.9	28.2	–

76. Methamphetamine-Related Deaths Before and After Prescription Pseudoephedrine Legislation

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Background: National and statewide laws to control methamphetamine precursors including pseudoephedrine have been enacted to decrease clandestine lab manufacture and subsequent availability/use of methamphetamine. In 2006, Oregon enacted a law requiring a prescription to obtain pseudoephedrine. No such law exists in Washington, which is thought to share similar sources of methamphetamine. The short- and long-term effect of Oregon's statewide pseudoephedrine law on methamphetamine-related deaths is unknown.
Hypothesis: The 2006 Oregon law requiring a prescription for pseudoephedrine was associated with short- and long-term decreases in methamphetamine-related deaths.
Methods: Data on drug-related deaths from 2003 to 2012 was obtained from the Medical Examiner Offices of Multnomah County, Oregon including Portland, and from King County, Washington including Seattle. Methamphetamine-related deaths from the 3-year period immediately before the enactment of the law (2003–2005) were compared to deaths in the short (2007–2009) and longer term (2010–2012). The rates of change in deaths were then compared between the two similar metropolitan areas.
Results: When comparing years immediately preceding (2003–2005) and immediately following (2007–2009) the law, there was a nonsignificant decrease in methamphetamine-related deaths in both Multnomah County [−4 (−14 %); 95 % CI, 21, 29; p=0.591] and King County [−4 (−17 %); 95 % CI 19, 26; p=0.552]. When comparing 2003–2005 to later years (2010–2012), there was a nonsignificant increase in methamphetamine-related deaths in both Multnomah County [5 (19.5 %); 95 % CI 14, 24; p=0.383] and King County [5 (22.7 %); 95 % CI, 9, 19; p=0.260)]. There was no significant difference between deaths in Multnomah and King counties in the short term [RR 0.98 (95 % CI, 0.79, 1.23); p=0.910] or long term [RR, 1.05 (95 % CI, 0.79, 1.29); p=0.905].
Discussion: A 2006 Oregon law that required a prescription for pseudoephedrine was associated with no change in short- or long-term methamphetamine-related deaths compared to a similar county in a neighboring state that did not enact a law. The years immediately following the law were associated with a short-term decrease in methamphetamine-related deaths, but a similar trend was also seen in King County, Washington, suggesting alternative variables may have been contributing, including national legislation or changes in the methamphetamine source, purity, and price secondary to the decrease in methamphetamine labs.
Conclusion: The Oregon law restricting pseudoephedrine as prescription-only was not associated with a decrease in methamphetamine-related deaths.

Table (Abstract 76). Methamphetamine-related deaths per 100,000 population

	Multnomah County, OR	King County, WA
2003–2005	10.5	3.4
2007–2009	9.0	2.8
2010–2012	12.5	4.2

77. Methamphetamine-Related Poison Center Calls Following Prescription Pseudoephedrine Legislation

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Background: Multiple national and statewide laws to control methamphetamine precursors including pseudoephedrine have been enacted to decrease clandestine lab manufacture and subsequent availability/use of methamphetamine. In 2006, Oregon enacted a law requiring a prescription to obtain pseudoephedrine. No such law exists in Washington, which is thought to share similar sources of methamphetamine.
Hypothesis: That the 2006 Oregon legislation restricting pseudoephedrine decreased poison center calls in Oregon, but not Washington.
Methods: Methamphetamine-related calls involving human exposures from OPC and WPC were evaluated from 2003 to 2012 and adjusted for population. Methamphetamine-related calls from 2003 to 2005 were used for comparison as pre-law call volume. The number of pre-law calls was compared to calls in the short term (2007–2009) and longer term (2010–2012).
Results: Both the OPC and WPC had a statistically significant decrease in methamphetamine-related calls in the immediate post-law period [OPC, −89 calls (−62 %), 95 % CI, −56, −121 calls, p=0.007], [WPC −74 calls (−55 %), (95 % CI, −36, −112), p=0.014)]. However, by the later period (2010–2012), call volumes returned to their pre-law volumes [OPC, −14 (−10 %), (95 % CI, −24, 53), p=0.260, WPC, +13 (+10 %), (95 % CI, −60, 30), p=0.349). There was no difference between the change in volume in OR and WA in the short term (RR, 1.05; (95 % CI, 0.978, 1.13), p=0.166), whereas in the long term, OPC's call volume decreased 10 % and WPC's call volume increased 10 %, a difference that was statistically significant (RR 1.10, (95 % CI, 1.002, 1.21); p=0.044).

Discussion: The initial decrease in methamphetamine-related poison center calls was seen in both Oregon and Washington, indicating that a possible confounding variable may have contributed to decreased methamphetamine-related calls. The initial decrease may represent a decline in methamphetamine use in the community or a change in potency/price resulting in decreased hospital admissions or emergency department visits. However, over a longer period, the call volume of both centers increased to levels similar to those in the pre-law periods, though Oregon call volumes remained decreased in the long term compared to Washington calls.
Conclusion: A law restricting pseudoephedrine in Oregon was associated with a small long-term decrease in methamphetamine-related poison center call volume in Oregon compared to Washington. In the short term, the law was associated with a decrease in methamphetamine-related calls in both states.

Table (Abstract 77). Human methamphetamine exposure calls per 100,000 population

	Oregon	Washington
2003–2005	11.2	6.0
2007–2009	4.2	2.7
2010–2012	10.1	6.6

78. The Association of Methamphetamine Rehabilitation Admissions with an Oregon Law Restricting Pseudoephedrine

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Background: The western states of Washington, Oregon, and California have seen a decrease in the number of clandestine labs after implementation of national and statewide regulations to control methamphetamine precursors, including pseudoephedrine. In September 2006, an even more restrictive law was enacted in Oregon requiring a prescription to obtain pseudoephedrine, which is not a part of Washington or California law. The effect of this law on methamphetamine use and subsequent admissions to rehabilitation treatment centers for methamphetamine abuse is unknown.
Hypothesis: The 2006 Oregon law requiring a prescription to obtain pseudoephedrine was associated with a change in treatment admissions for methamphetamine abuse as compared to neighboring states without similar laws.
Methods: The Treatment Episode Data Set (TEDS) from the Substance Abuse and Mental Health Services Administration (SAMHSA) was evaluated for Oregon, Washington, and California from 2003 to 2009. The number of admissions to rehabilitation centers for methamphetamine abuse from 2003 to 2005 was compared to postlegislation admissions from 2007 to 2009 in Oregon, Washington, and California.
Results: In Oregon, there were 683 admissions/100,000 population to methamphetamine treatment centers from 2003 to 2005 and 592 admissions from 2007 to 2009, representing a decrease in admissions by 13 % after enactment of the legislation. In the same time period, the rate of admissions to rehabilitation centers for methamphetamine abuse in California decreased by 6 % and in Washington increased by 1 % (CA and WA=3.9 %). There was no statistically significant difference when the rate of change of Oregon admissions was compared to Washington and California [RR=1.051 (95 % CI, 0.978, 1.129)].
Discussion: The 2006 law in the state of Oregon restricting pseudoephedrine to prescription-only had no significant effect on treatment admissions for methamphetamine. Future research may be directed at determining which other factors, such as drug purity or price or the source of methamphetamine (e.g., local production versus Mexico) may have on treatment admissions.
Conclusion: Restricting pseudoephedrine to prescription-only in the state of Oregon had no effect on methamphetamine treatment admissions.

Table (Abstract 78). Methamphetamine rehabilitation admissions per 100,000 population

	Oregon	Washington	California
2003–2005	683	237	509
2007–2009	592	240	477

79. Association of Methamphetamine Lab Incidents in States with Prescription Pseudoephedrine Laws

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Background: Multiple national and statewide laws have been enacted to control the precursors for clandestine manufacture of methamphetamine. Currently, Oregon and Mississippi are the only states to require a prescription to obtain pseudoephedrine. A decrease in clandestine methamphetamine lab incidents has been demonstrated after enactment of these laws in these states, but it is unclear if other comparable states were seeing a similar decrease, suggesting possible national or regional confounding variables.
Hypothesis: There was a more significant decrease in methamphetamine lab incidents in Oregon and Mississippi as compared to surrounding states without a law requiring a prescription for pseudoephedrine.
Methods: Drug Enforcement Agency data on number of clandestine laboratory incidents by state was evaluated from 2004 to 2012. The Oregon law was enacted in 2006, and the number of labs in Oregon was evaluated for the period before the law (2004–2005) and compared to lab incidents in the short (2007–2008) and long term (2011–2012). The rates of change in number of lab incidents were compared to neighboring states Washington and California. Mississippi lab incidents were evaluated from 2008 to 2009 before the law was enacted in 2010, and compared to post-implementation period (2011–2012). The number of labs in Mississippi was compared to neighboring states Louisiana, Alabama, Arkansas, Missouri, and Tennessee.
Results: Total methamphetamine lab incidents in Oregon decreased significantly more than Washington and California (90 vs. 64 %) in the 2 years after the legislation [RR=1.24 (95 % CI, 1.210, 1.275)]. Over the longer term, methamphetamine lab incidents in Oregon decreased significantly more than Washington and California (98 vs. 95 %) over the 9-year period from 2004 to 2012 [RR=1.024 (95 % CI, 1.011, 1.037)]. Mississippi methamphetamine lab incidents decreased significantly more than the surrounding states (76 vs. 38 %) of Tennessee, Arkansas, Alabama, Louisiana, and Missouri [RR=1.310 (95 % CI, 1.278, 1.344)].
Discussion: Pseudoephedrine legislation was associated with a significant reduction of methamphetamine lab incidents in both states when compared to neighboring states. There was significant heterogeneity between states in the incidence of methamphetamine labs over the 9-year study period.
Conclusion: Legislation in both Oregon and Mississippi that restricted pseudoephedrine to prescription-only decreased methamphetamine laboratory incidents when compared to surrounding states without such legislation.

Table (Abstract 79). Methamphetamine lab incidents per 100,000 population

State	Prelegislation	Immediate post-leg	Long term
OR	22.6	2.3	0.5
WA	22.3	5.5	0.6
CA	3.4	1.7	0.5

State	Prelegislation	Immediate post-leg	Long term
MS	46.4	11.0	
LA	4.5	2.9	
AL	26.9	10.1	
AR	36.5	13.1	
MO	85.2	65.1	
TN	36.5	61.5	

80. Observational Study of Dabigatran and Rivaroxaban Exposures Reported to a Poison Control System

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Background: Dabigatran and rivaroxaban are newer anticoagulants being used more commonly in clinical practice. Cases of bleeding have been reported with use of these agents since approval. We performed an observational case series to characterize the presentation and outcome of exposures to these medications.
Methods: Combined retrospective and prospective case series of exposures to dabigatran and rivaroxaban reported to our poison control system. Retrospective cases were identified between 1/11 and 5/12. Prospectively collected cases were collected from May 2012 to July 2013. Miscoded cases and those with possible warfarin co-ingestion were excluded. Other cases of co-ingestion were included. Main data variables collected included demographics, outcome, disposition, nature of exposure, treatments received, and laboratory parameters.
Results: Fifty-seven total cases were identified, with 7 excluded, leaving 37 dabigatran and 12 rivaroxaban cases for analysis. Children age 12 or less accounted for five dabigatran and two rivaroxaban cases. Bleeding was reported in 15 dabigatran cases. There were four cases of acute self-harm overdose with dabigatran ranging from 1,800 to 3,900 mg. Mild bleeding was reported in only one of these overdose cases and there were no deaths in this group. There were two fatal hemorrhages in dabigatran cases, both in patients chronically on this medication. Coagulation parameters were abnormal in many cases and did not correlate well with bleeding or outcome. Bleeding was reported in five rivaroxaban cases, all in patients with chronic exposure to the drug without known overdose. No cases of intentional self-harm overdose of rivaroxaban were reported, and there were no deaths. None of the pediatric cases from either group had adverse outcomes or bleeding.
Discussion: Adverse bleeding will continue to rise with exposures to the newer oral anticoagulants. Our data demonstrated that chronic dosing of these agents resulted in more episodes of bleeding than intentional overdose or excess dosing. Accidental pediatric exposures also resulted in few effects and no episodes of bleeding.
Conclusion: This case series of dabigatran and rivaroxaban exposures demonstrated the greatest degree of risk of adverse events in patients chronically taking these medications irrespective of excess dosing. Acute self-harm ingestions and accidental pediatric ingestions in our series had few adverse effects.

81. Methemoglobinemia as a Complication of Topical Dapsone

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Background: Methemoglobinemia may result from a wide variety of oxidant stressors. Dapsone and its acetylated metabolite, dapsone hydroxylamine, are known oxidants and have been frequently reported as a cause of methemoglobinemia. Topical dapsone has not been previously reported as a cause of methemoglobinemia. We present a case of methemoglobinemia after using topical dapsone 5 % gel for facial acne.
Hypothesis: Topical dapsone has the potential to cause methemoglobinemia.
Methods: This is a single-patient chart review. A 19-year-old female without significant past medical history presented to the emergency department with blue lips and nail beds. Her home medications included citalopram, topical dapsone (Aczone®), and oral contraceptives. She awoke on the day of presentation and noted that her lips and fingers were blue. She complained of a mild headache and mild shortness of breath. Initial vital signs were normal except for an oxygen saturation of 82 % on room air. Her dyspnea persisted despite treatment with 2 l per minute of oxygen by nasal cannula. Oxygen saturation increased to 90 % following treatment with oxygen. Chest radiograph and electrocardiogram were normal. Laboratory studies were within normal limits (Hgb, 12.4 mg/dL) except for a methemoglobin (MetHgb) level of 20.3 %. She was treated with a single intravenous bolus of 2 mg/kg methylene blue which resulted in complete resolution of her cyanosis and symptoms. A repeat MetHgb level 120 min after treatment was 1.9 %. A urine gas chromatography/mass spectrometry qualitative drug screen demonstrated dapsone. Nine hours after treatment, her MetHgb level was 7.2 %, she was asymptomatic, and was therefore discharged home.
Case discussion: We hypothesize this patient's methemoglobinemia was the result of systemic absorption of topical dapsone gel.
Conclusions: Topical dapsone gel may be absorbed systemically thereby causing oxidant stress and resulting in methemoglobinemia.

82. ST Elevation Myocardial Infarction Presenting as a Complication of *Crotalus horridus* Envenomation

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Background: Myocardial infarction (MI) has been reported previously as a complication of snake envenomation. To our knowledge, ST-elevation MI (STEMI) has not been previously reported as a complication of North American crotaline envenomation.
Hypothesis: Rattlesnake envenomation can cause MI by a mechanism not yet clearly elucidated.
Methods: This is a single-patient chart review. A 72-year-old male presented to the emergency department (ED) with chest pain shortly after being bitten by a juvenile canebrake rattlesnake (*Crotalus horridus*). EMS was called and en route to the ED the patient developed chest pain and hypotension. His vital signs on arrival were T 97.4, HR 89, RR 28, BP 96/72, O2 saturation 100 % on non-rebreather mask. Swelling was present over the left dorsal hand and a single puncture wound was noted on the second digit.
Results: The initial EKG demonstrated ST elevation in leads II, III, and aVF. Laboratory results included 9.7 WBC, 13.2 Hgb, 524 Plt, 12.3/0.9 PT/INR, 28.9 PTT, 712 fibrinogen, and troponin was elevated at 0.24. Hypotension resolved following a 1,000 cm^3 bolus of 0.9 % saline. Rectal aspirin (300 mg), heparin, and six vials of crotaline Fab antivenom were administered in the emergency department. The patient was admitted for emergent cardiac catheterization and intubated for ongoing hypoxia. The circumflex artery revealed a 70–80 % midvessel stenosis with thrombus formation. There was additional thrombus formation just proximal to the branching point of the second obtuse marginal branch. After thrombectomy and stent implantation, there was no residual obstruction. The patient was extubated on hospital day #2. Fourteen vials of crotaline Fab antivenom were administered. He was discharged to home in good condition after 6 days in the hospital.
Discussion: Complex hematologic abnormalities such as platelet aggregation are well described following crotaline envenomation including recognized species-dependent effects. In this patient with moderate coronary atherosclerosis, thrombus formation could be a complication of the hemotoxic venom effect of *C. horridus*. With the common use of

anticoagulation and platelet-inhibiting medications in the setting of STEMI, management of STEMI in conjunction with crotaline envenomation presents unique challenges.
Conclusions: STEMI is a rare but potential life-threatening complication of North American crotaline envenomation.

83. Inverse Takotsubo Cardiomyopathy after Methamphetamine Use

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Background: Takotsubo cardiomyopathy (TC) is a reversible cause of heart failure caused by high adrenergic outflow. It is characterized by apical ballooning with hypokinesis. In inverse TC, the heart's apex is either normal or hyperdynamic with a hypokinetic base. There are several case reports of drug-induced TC, although very few cases of drug-induced inverse TC are described.
Hypothesis: Methamphetamine use is associated with inverse TC.
Methods: This is a case report of a 17-year-old man with history of heroin, marijuana, and amphetamine abuse who complained of 3 days of worsening nausea, vomiting, and acute onset of chest pain after using marijuana and methamphetamine.
Results: Patient was afebrile with a heart rate of 143 bpm, respiratory rate of 50 bpm, blood pressure of 109/64, and oxygen saturation of 77 % on room air. Exam revealed bilateral rales. No murmurs or peripheral edema was noted. CXR showed pulmonary edema with normal cardiac silhouette. Echocardiography revealed a dilated left ventricle, severely diminished motion in the basal and mid-wall segments, normal apical contraction, and a left ventricular ejection fraction (LVEF) of 29 %. Troponin I was 4.68 ng/mL (<0.05 ng/mL). Pro-BNP was 18,701 pg/mL (<1,584 pg/mL). Urine GC/MS confirmed presence of methamphetamine, amphetamine, and cannabinoids. An echo on day 2 revealed improved cardiac function (LVEF 38 %) On day 5, a left atrial thrombus was noted, and was treated with tPA and systemic anticoagulation. Eleven days after exposure, patient's LVEF was 41 %. He was discharged on lisinopril, spironolactone, carvediolol, furosemide, and coumadin.
Discussion: The lack of upper respiratory symptoms, along with the temporal association between stimulant use and symptom onset, and the rapid improvement all suggest drug-induced etiologies, as opposed to a viral etiology. Very few cases have been reported on methamphetamine or amphetamine induced TC. Methamphetamine abusers may be at higher risk of developing cardiomyopathies compared to age-matched nonusers. Many of the reported cardiomyopathies are transient, as with TC and inverse TC. Mural thrombus is a known complication. LVEF and wall motion abnormalities should improve within 3–5 days and should return to baseline function within days to weeks.
Conclusion: Methamphetamine use may lead to inverse Takotsubo cardiomyopathy.

84. ACMT International Member Survey, Summer 2013

Vohra R[1], Gosselin S[2], Wong A[3], Kopec K[4], Gunja N[5], On behalf of the ACMT International Committee
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Introduction: The ACMT's International Committee was formed in 2008 to unite a diverse, geographically diffuse group of medical toxicology educators and researchers.
Research question: How do international ACMT members self-evaluate their interested, goals, and priorities, and how can their responses guide strategic planning for this globally distributed network of toxicologists with diverse skills and needs?
Methods: A nine-question online survey was created in summer 2013 with input from International Committee members and ACMT leadership. We requested all international ACMT members provide feedback about their current responsibilities, projects, short- and long-term goals, and how ACMT and the International Committee could serve their professional and educational needs.
Results: There were 32 responses from 12 countries. The primary employment areas of respondents were bedside or inpatient consultation services (81 %), poison control centers, medical education, research, and public health agencies. The most common areas of interest within toxicology included pharmaceutical drug toxicity (65 %), pesticides, agrochemicals, emerging illicit drugs, and snakebites. Topics desired for continuing education included heavy metals, medico-legal issues, emerging drugs, addiction medicine, industrial and occupational toxicology, radiation safety, and grant-writing/research funding opportunities. Funding remains a common barrier to international members' goals (31 %). Accreditation of international members as fellows of ACMT is highly valued in countries which lack other official medical toxicology recognition. When asked how ACMT could better serve their needs, members requested more online continuing education aimed at skill transfer to local specialists in emergency medicine and toxicology, and facilitating research collaborations within the worldwide toxicology community. Finally, over 20 international conferences and scientific meetings were suggested for possible ACMT-sponsored symposia, where members could work with regional medical communities to explore ways that medical toxicologists can help address the global epidemic of poisonings worldwide.
Conclusions: Online education, collaborative research, international conference participation, and grant provision were the most commonly expressed themes from the survey responses. Although limited by the small sample size, this survey experience provides valuable insight for restructuring the International Committee and formulating its strategic plan.

85. Is It PrimeTime for FaceTime? VideoTelephone App Use in Toxicology Consultations

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Introduction: Poison control centers pioneered the use of telephones for remote medical direction over 50 years ago, but newer telemedicine technologies have recently emerged. We present three clinical cases where video-telephone calls using Apple Inc's "FaceTime" application facilitated toxicology consultation in an emergency department.
Research Question: Is FaceTime a useful adjunct for medical toxicology consultations?
Case reports: (A) Aspirin toxicity was suspected in a 55-year-old man with a prior medical history of tuberculosis who presented with respiratory distress. FaceTime was used to confirm the patient's salicylism toxidrome (diaphoresis, tinnitus, confusion, and respiratory distress) as well as radiographs demonstrating TB scars and pulmonary edema. These visual details prompted a recommendation for emergency hemodialysis, even though lab results were pending. A salicylate level of 96 mg/dL was resulted just as hemodialysis was begun. (B) A 42-year-old man with anxiety, chest pain, and headaches admitted to taking amyl nitrate "poppers" just prior to arrival. FaceTime confirmed the presence of perioral and nailbed cyanosis, and oxygen saturation of 88 % despite oxygen supplementation. Empiric therapy with methylene blue supplementation was recommended, the patient's labs revealed methemoglobin level of 24 % and an elevated troponin (0.56 ng/dL). (C) A 6-year-old developmentally delayed girl swallowed dilute bleach from a mislabeled bottle. After choking and gagging initially, she returned to her baseline state, which

included mutism and a predilection to drooling. FaceTime consultation with a toxicologist assured the emergency clinician and the patient's parents that the child was safe for discharge following an oral fluids trial.
Discussion: Nonrecorded video-phone technology represents an innovation for potentially enhancing valuable interactions between toxicologists, health professionals, and patients and relatives. Select physical examination findings, ECGs, and radiographs are types of data which can be transmitted effectively over FaceTime.
Conclusion: By facilitating real-time diagnosis, bedside education, and visual feedback among practitioners and consultants, videophone calls can enhance toxicology consultation and clinical outreach in an era of declining telephone call volumes to poison centers nationwide. A larger set of clinical experiences is needed to explore the place of these types of technologies in the changing landscape of medical toxicology.

Table (Abstract 85). Treatment decisions affected by using the FaceTime application

Case	Clinical details	Visual data transmitted	Treatment decisions
A	55 years old with ASA toxicity	Salicylism toxidrome, CXR	Emergency hemodialysis
B	42 years old with amyl nitrate OD	Perioral/ peripheral cyanosis	Empiric methylene blue therapy
C	6 years old with bleach ingestion	Oral mucosal examination	Discharged after brief observation

86. Serotonin Syndrome Precipitated by Methylene Blue Administration for Treatment of Methemoglobinemia

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Background: Methylene blue is a phenothiazine derivative used clinically as an antidote for methemoglobinemia, as a surgical dye, and as a vasopressor in refractory vasodilatory shock. Both methylene blue and its primary metabolite, azure B, are inhibitors of monoamine oxidase A.
Hypothesis: Methylene blue has sufficient inhibition of monoamine oxidase A to precipitate serotonin syndrome (SS), even at low doses.
Methods: This is a single-patient chart review. A 38-year-old female with a past medical history of depression, carcinoid syndrome, and dermatographia presented to the emergency department with palpitations and fatigue. She reported a recent history of lethargy, anxiety, and lightheadedness. She was taking dapsone for 12 months and had started paroxetine a few weeks prior. Initial vital signs were T 98.6, HR 146, BP 169/104, RR 22, and SatO2 90 %. Her SatO2 did not improve with 100 %. Her workup was unremarkable (Hgb, 13 mg/dL) except for a methemoglobin (MetHgb) level of 20.8 %. She was given a dose of methylene blue 1 mg/kg which was repeated after she failed to improve. During transfer, she became diaphoretic, myoclonic, agitated, and intermittently confused. Her MetHgb level had decreased to 2.6 % after treatment but rebounded to 9.0 % on hospital day 2. Vital signs on arrival were T 98.6, HR 133, RR 16, BP 153/83, and SatO2 95 %. She was awake, alert, anxious, and profusely diaphoretic. She was slow to respond to questions and had mild trismus. She had repetitive flexion and extension of her left lower extremity which was difficult for her to control. She had concurrent rigid lower extremities and sustained clonus at the knees and ankles. She was diagnosed with SS by a medical toxicologist. She was treated with intravenous lorazepam for these symptoms. Her symptoms resolved within 24 h and her vital signs normalized. A urine gas chromatography/mass spectrometry demonstrated paroxetine, dapsone, and methylene blue.
Discussion: We report a case of serotonin syndrome in the setting of low-dose administration of methylene blue for the treatment of symptomatic methemoglobinemia.
Conclusions: Concurrent use of methylene blue with serotonergic xenobiotics at doses as low as 2 mg/kg can precipitate serotonin syndrome.

87. Stress-Induced Cardiomyopathy Resulting from Abstinent Opioid Withdrawal

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Background: Stress-induced cardiomyopathy is a transient non-ischemic cardiomyopathy, usually caused by an acute physical or emotional stressor that presents with findings concerning for acute coronary syndrome despite lack of angiographic coronary artery disease. Rare case reports have described this phenomenon in the setting of iatrogenic opioid withdrawal. In our case, stress-induced cardiomyopathy occurred after discontinuation of opioid medications.
Hypothesis: Abstinent opioid withdrawal can induce stress-induced cardiomyopathy.
Methods and Results: This is a single-patient chart review. The patient is a 37-year-old male with a history of oxycodone, heroin, and fentanyl abuse who presented to the Emergency Department with a chief complaint of opioid withdrawal symptoms 5 days after last using oxycodone. He denied recent opioid or other drug use. On presentation, he was agitated, nauseated, tachypneic, diaphoretic, and complained of diffuse abdominal pain. Initial vital signs were temperature (36.8 °C), blood pressure (147/98), pulse (88), respiratory rate (32), and saturating (98 %) on room air. Urine drug screen was positive for opiates only. Four milligrams of lorazepam and 4 mg of midazolam were administered in attempt to control his agitation. Due to uncontrolled agitation, the patient was intubated. Further evaluation revealed diffuse ST segment depression on EKG with elevated serum troponin (initial 14 ng/mL, peak 44 ng/mL). A previous EKG from 1-year prior was normal. Cardiology was consulted and the patient started on aspirin, clopidogrel, and heparin. The patient underwent coronary angiography that revealed normal coronaries and left ventriculography demonstrated diffuse left ventricular hypokinesis with apical sparing and an ejection fraction of 15 %. He was diagnosed with non-ischemic cardiomyopathy and started on aspirin, lisinopril, hydrochlorothiazide, and carvedilol. The patient left against medical advice on hospital day 3, therefore no follow up was obtained.
Discussion: We believe that the patient developed stress-induced cardiomyopathy from opioid withdrawal secondary to abstinence. He was found to have new ST changes on EKG, troponin elevation with no evidence of coronary artery disease, and diffuse LV hypokinesis, this presentation is consistent with the Mayo diagnostic criteria for stress cardiomyopathy.
Conclusion: Severe non-ischemic cardiomyopathy may occur as a complication of opioid withdrawal due to abstinence.

88. Successful Physostigmine Treatment of Delirium Induced by Clozapine Adulterated Street Drugs

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Background: Physostigmine is used for the treatment of antimuscarinic toxicity. Our consult service regularly uses this antidote to treat coma and delirium from certain atypical antipsychotics (e.g., quetiapine, olanzapine). Clozapine is an atypical antipsychotic with mixed muscarinic agonist/antagonist effects.
Hypothesis: Physostigmine treatment may help resolve antimuscarinic effects and CNS depression in clozapine overdose.
Methods: This is a single-patient chart review. A 37-year-old male with polysubstance abuse was found unconscious beside a bag of pink powder.

EMS found the patient obtunded with respiratory failure. A total of 1.5 mg naloxone was administered with no improvements. On presentation, the patient was comatose and required emergent intubation due to respiratory failure and need for airway stabilization. Vitals included HR of 120 beats/min, BP of 122/78 mmHg, RR of 10 breaths/min, and O_2 saturation of 93 % via non-rebreather. Foley catheter placement yielded 2 l of urine. The patient did not require sedation for intubation. Initially, copious secretions required oropharyngeal suctioning. Miosis was also present along with hypoactive bowels and relaxed neuromuscular tone. EKG showed sinus tachycardia and QTc of 490 ms. Urine drug screen was positive for benzodiazepines and comprehensive screen confirmed methadone and clozapine (which the patient was not prescribed). Within 12 h, the patient awoke and was extubated; however, paroxysms of agitated delirium interspersed with somnolence required restraints be used. Miosis, tachycardia, absent bowel sounds, and dry skin were still present and a fever had developed (38 °C). At this point, he had a very dry mouth as well.

Results: Toxicology administered 2 mg of physostigmine resulting in dramatic lucidity with marked improvement in level of consciousness, heart rate, and normal salivation. Restraints were removed and he admitted to buying a powder he was told contained heroin and benzodiazepines (no heroin was present) but suspected to have contained only clozapine. He required no further antidote and was subsequently discharged.

Discussion: There are only two previous publications from the 1970s describing physostigmine treatment of clozapine toxicity in overdose.

Conclusions: Physostigmine may reverse CNS depression and significant antimuscarinic effects and improve overall patient care in clozapine overdose.

Previously Presented and Previously Published Research: Poster Presentations

89. Darracq MA, Rentmeester L, Cullen J, Cantrell FL. "Orbeez": The magic absorbing bead—risk of pediatric bowel obstruction? *Clin Toxicol* 2013; 51(7):588.

90. Darracq MA, Devgun J, Chen X, Cantrell FL. FUNGUS AMONGUS: Testing the public's ability to identify mushrooms. *Clin Toxicol* 2013; 51(7):650.

91. Ordonez J, Forrester MB, Kleinschmidt K. Electronic cigarette exposures reported to poison centers. *Clin Toxicol* 2013; 51(7):685.

92. Ordonez J, Morrester MB, Kleinschmidt K. Comparison of diphenhydramine and Datura abuse. *Clin Toxicol* 2013; 51(7):702-3.

93. Finkelstein Y, Hollands S, Sivilotti ML, Hutson JR, Mamdani MM, Macdonald E, Juurlink DN. Long-term outcomes following deliberate self poisoning: a 10-year longitudinal population-based study. *Clin Toxicol* 2013; 51(7):576.

94. Thornton S, Akpunonu P, Luu S, Brudevole J, Lee P, Cantrell FL. Prevalence and characteristics of hypofibrinogenemia after North American rattlesnake envenomation reported to a statewide poison control system. *Clin Toxicol* 2013; 51(7):620.

95. Arroyo-Plasencia AM, Schwarz ES, Velez LI, Hail SJ, Kao LW, Kleinschmidt KC, Young A. Physostigmine. *Clin Toxicol* 2013; 51(7):690–1.

96. Dissanayake V, Senanayake MP, Perera RP. Made to deliver: a comparison of lead contamination in imported and non-imported spices. *Clin Toxicol* 2013; 51(7):641.