CURRENT AWARENESS PAPERS OF THE MONTH

The implementation of medical monitoring programs following potentially hazardous exposures: a medico-legal perspective


Context
Clinical toxicologists may be called upon to determine the appropriateness of medical monitoring following documented or purported exposures to toxicants in the occupational, environmental, and medical settings.

Methods
We searched the MEDLINE database using the Ovid® search engine for the following terms cross-referenced to the MeSH database: ("occupational exposures" OR "environmental exposures") AND ("physiologic monitoring" OR "population surveillance"). The titles and abstracts of the resulted articles were reviewed for relevance. We expanded our search to include non-peer-reviewed publications and gray literature and resources using the same terms as utilized in the MEDLINE search. There were a total of 48 relevant peer-reviewed and non-peer-reviewed publications. Publications excluded contained no information relevant to medical monitoring following potentially harmful toxicologic exposures, discussed only worker screening/surveillance and/or population biomonitoring, contained redundant
information, or were superseded by more recent information.

**Approaches to medical monitoring**
A consensus exists in the peer-reviewed medical literature, legal literature, and government publications that for medical monitoring to be a beneficial public health activity, careful consideration must be given to potential benefits and harms of the program. Characteristics of the exposure, the adverse human health effect, the screening test, and the natural history of the disease are important in determining whether an exposed population will reap a net benefit or harm from a proposed monitoring program.

**Broader interpretations of medical monitoring**
Some have argued that medical monitoring programs should not be limited to exposure-related outcomes but should duplicate general preventive medicine efforts to improve public health outcomes although an overall reduction of morbidity, mortality and disability by modifying correctable risk factors and disease conditions. This broader approach is inconsistent with the targeted approach advocated by the Agency for Toxic Substances and Disease Registry and the United States Preventive Services Task Force and the bulk of the peer-reviewed medical literature.

**Medical monitoring in legal contexts**
Numerous medical monitoring actions have been litigated. Legal rationales for allowing medical monitoring claims often incorporate some of the scientific criteria for the appropriateness of monitoring programs. In the majority of cases in which plaintiffs were awarded medical monitoring relief, plaintiffs were required to demonstrate both that the condition for which medical monitoring was sought could be detected early, and that early detection and treatment will improve morbidity and mortality. However, the treatment of medical monitoring claims varies significantly depending upon jurisdiction.

**Examples of large-scale, comprehensive medical monitoring programs**
Large-scale, comprehensive medical monitoring programs have been implemented, such as the Fernald Medical Monitoring Program and the World Trade Center Health Program, both of which exceeded the scope of medical monitoring typically recommended in the peer-reviewed medical literature and the courts. The Fernald program sought to prevent death and disability due to non-exposure-related conditions in a manner similar to general preventive medicine. The World Trade Center Health Program provides comprehensive medical care for World Trade Center responders and may be viewed as a large-scale, federally--funded research effort, which distinguishes it from medical monitoring in a medico-legal context.

**Synthesis of public health approaches to medical monitoring**
Medical monitoring may be indicated following a hazardous exposure in limited circumstances. General causation for a specific adverse health effect must be either established by scientific consensus through a formal causal analysis using a framework such as the Bradford-Hill criteria. The exposure must be characterized and must be of sufficient severity that the exposed population has a significantly elevated risk of an adverse health effect. Monitoring must result in earlier detection of the condition than would otherwise occur and must confer a benefit in the form of primary, secondary or tertiary prevention. Outcome tables may be of use in describing the potential benefits and harms of a proposed monitoring program.

**Conclusions**
In the context of litigation, plaintiffs may seek medical monitoring programs after documented or putative exposures. The role of the clinical toxicologist, in this setting, is to evaluate the scientific justifications and medical risks and assist the courts in determining whether monitoring would be expected to result in a net public health benefit.

Full text available from: [http://dx.doi.org/10.1080/15563650.2017.1334913](http://dx.doi.org/10.1080/15563650.2017.1334913)
Massive paracetamol overdose: an observational study of the effect of activated charcoal and increased acetylcysteine dose (ATOM-2)


Context
Paracetamol is commonly taken in overdose, with increasing concerns that those taking "massive" overdoses have higher rates of hepatotoxicity and may require higher doses of acetylcysteine. The objective was to describe the clinical characteristics and outcomes of "massive" (≥ 40 g) paracetamol overdoses.

Methods
Patients were identified through the Australian Paracetamol Project, a prospective observational study through Poisons Information Centres in NSW and Queensland, over 3 and 1.5 years, respectively, and retrospectively from three clinical toxicology unit databases (over 2.5 to 20 years). Included were immediate-release paracetamol overdoses ≥ 40 g ingested over ≤ 8 h. Outcomes measured included paracetamol ratio [defined as the ratio of the first paracetamol concentration taken 4–16 h post-ingestion to the standard (150 mg/L at 4 h) nomogram line at that time] and hepatotoxicity (ALT >1000 U/L).

Results
Two hundred paracetamol overdoses were analysed, reported median dose ingested was 50 g (interquartile range (IQR): 45–60 g) and median paracetamol ratio 1.9 (IQR: 1.4–2.9, n = 173). One hundred and ninety-three received acetylcysteine at median time of 6.3 h (IQR: 4–9.3 h) post-ingestion. Twenty-eight (14%) developed hepatotoxicity, including six treated within 8 h of ingestion. Activated charcoal was administered to 49(25%), at median of 2 h post-ingestion (IQR:1.5–5 h). Those receiving activated charcoal (within 4 h of ingestion), had significantly lower paracetamol ratio versus those who did not: 1.4 (n = 33, IQR: 1.1–1.6) versus 2.2 (n = 140, IQR: 1.5–3.0) (p < .0001) (paracetamol concentration measured ≥ 1 h after charcoal). Furthermore, they had lower rates of hepatotoxicity [unadjusted OR: 0.12 (95% CI: <0.001–0.91); adjusted for time to acetylcysteine OR: 0.20 (95%CI: 0.002–1.74)].

Seventy-nine had a paracetamol ratio ≥2, 43 received an increased dose of acetylcysteine in the first 21 h; most commonly a double dose in the last bag (100 to 200 mg/kg/16 h). Those receiving increased acetylcysteine had a significant decrease risk of hepatotoxicity [OR:0.27 (95% CI: 0.08–0.94)]. The OR remained similar after adjustment for time to acetylcysteine and paracetamol ratio.

Conclusion
Massive paracetamol overdose can result in hepatotoxicity despite early treatment. Paracetamol concentrations were markedly reduced in those receiving activated charcoal within 4 h. In those with high paracetamol concentrations, treatment with increased acetylcysteine dose within 21 h was associated with a significant reduction in hepatotoxicity.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1334915
The standard treatment protocol for paracetamol poisoning may be inadequate following overdose with modified release formulation: a pharmacokinetic and clinical analysis of 53 cases

Objective
The use of the standard procedure for managing overdoses with immediate release (IR) paracetamol is questionable when applied to overdoses with modified release (MR) formulations. This study describes the pharmacokinetics of paracetamol and the clinical outcomes following overdoses with a MR formulation.

Methods
Medical records including laboratory analyses concerning overdoses of MR paracetamol from 2009 to 2015 were collected retrospectively. Inclusion criteria were ingestion of a toxic dose, known time of intake and documented measurements of serum paracetamol and liver function tests. Graphical analysis, descriptive statistics and population pharmacokinetic modelling were used to describe data.

Results
Fifty-three cases were identified. Median age was 26 years (range 13–68), median dose was 20 g (range 10–166) and 74% were females. The pharmacokinetic analysis showed a complex, dose dependent serum versus time profile with prolonged absorption and delayed serum peak concentrations with increasing dose. Ten patients had persistently high serum levels for 24 h or more, six of them had a second peak 8-19 h after ingestion. Seven of 34 patients receiving N-acetylcysteine (NAC) within 8 h had alanine aminotransferase (ALT) above reference range. Three of them developed hepatotoxicity (ALT >1000 IU/l).

Discussion and conclusions
The pharmacokinetic and clinical analysis showed that the standard treatment protocol, including risk assessment and NAC regimen, used for IR paracetamol poisoning not appear suitable for MR formulation. Individual and tailored treatment may be valuable but further studies are warranted to determine optimal regimen of overdoses with MR formulation.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1339887

The toxicological significance of post-mortem drug concentrations in bile

Context
Some authors have proposed that post-mortem drug concentrations in bile are useful in estimating concentrations in blood. Both The International Association of Forensic Toxicologists (TIAFT) and the US Federal Aviation Administration recommend that samples of bile should be obtained in some circumstances. Furthermore, standard toxicological texts compare blood and bile concentrations, implying that concentrations in bile are of forensic value.

Aim
To review the evidence on simultaneous measurements of blood and bile drug concentrations reported in the medical literature.

Methods
We made a systematic search of EMBASE 1980–2016 using the search terms ("bile/" OR
"exp drug bile level/concentration/" AND "drug blood level/concentration/", PubMed 1975-2017 for ("bile[tw]" OR "biliary[tw]" OR "concentration[tw]" OR "concentrations[tw]" OR "level[tw]" OR "levels[tw]") AND "post-mortem[tw]" and also MEDLINE 1990–2016 for information on drugs whose biliary concentrations were mentioned in standard textbooks. The search was limited to human studies without language restrictions. We also examined recent reviews, indexes of relevant journals and citations in Web of Science and Google Scholar. We calculated the bile:blood concentration ratio. The searches together yielded 1031 titles with abstracts. We scanned titles and abstracts for relevance and retrieved 230, of which 161 were considered further. We excluded 49 papers because: the paper reported only one case (30 references); the data referred only to a metabolite (1); the work was published before 1980 (3); the information concerned only samples taken during life (10); or the paper referred to a toxin or unusual recreational drug (5). The remaining 112 papers provided data for analysis, with at least two observations for each of 58 drugs.

**Bile:blood concentration ratios**

Median bile:blood concentration ratios varied from 0.18 (range 0.058–0.32) for dextromoramide to 520 (range 0.62–43,000) for buprenorphine. Median bile concentrations exceeded blood concentrations by one order of magnitude for several drugs, including dihydrocodeine, quetiapine and sildenafil; and by two orders of magnitude of for buprenorphine, colchicine and 3,4-methylenedioxymethamphetamine (MDMA), among others. The minimum and maximum values for the ratio differed by a factor of three or more in three-quarters of the cases where data were available and by a factor of 10 or more for over half of the analytes.

**Limitations**

The data were difficult to find. Medline does not explicitly index the term "drug bile concentration". It may well be that other reports exist, although they would not alter our major conclusion. Many of the papers that contributed data failed to specify the source of the blood samples or the post-mortem interval, so that no judgment was possible regarding post-mortem redistribution in whole blood or bile.

**Conclusions**

For most drugs, there are wide ranges of bile:blood concentration ratios, which means that bile and blood concentrations are generally poorly correlated. Bile concentration measurements cannot readily be used to establish post-mortem blood concentrations; nor can they be extrapolated to ante-mortem concentrations. However, because drug concentrations in bile often exceed those in blood, bile may allow qualitative identification of drugs present, even when the blood concentration is below the limit of detection.

Full text available from: [http://dx.doi.org/10.1080/15563650.2017.1339886](http://dx.doi.org/10.1080/15563650.2017.1339886)

**Intraosseous administration of antidotes – a systematic review**


**Context**

Intraosseous (IO) access is an established route of administration in resuscitation situations. Patients with serious poisoning presenting to the emergency department may require urgent antidote therapy. However, intravenous (IV) access is not always readily available.

**Objective**

This study reviews the current evidence for IO administration of antidotes that could be used in poisoning. The primary outcome was mortality as a surrogate of efficacy. Secondary outcomes included hemodynamic variables, electrocardiographic variables, neurological
status, pharmacokinetics outcomes, and adverse effects as defined by each article.

**Methods**
A medical librarian created a systematic search strategy for Medline, subsequently translated to Embase, BIOSIS, PubMed, Web of Science, Cochrane, Database of Abstracts of Reviews of Effects (DARE), and the CENTRAL clinical trial register, all of which we searched from inception to 30 June 2016. Interventions included IO administration of selected antidotes. Articles included volunteer studies, poisoning, or other resuscitation contexts such as cardiac arrest, burns, dehydration, seizure, hemorrhagic shock, or undifferentiated shock. We considered all human studies and animal experiments to the exception of *in vitro* studies. Two reviewers independently selected studies, and a third adjudicated in case of disagreement. Three reviewers extracted all relevant data. Three reviewers evaluated the risk of bias and quality of the articles using specific scales according to each type of study design.

**Results**
A total of 47 publications (46 articles and one abstract) met our inclusion criteria and described IO administration of 13 different antidotes. These included one case series and 21 case reports describing 26 patients, and 25 animal experiments. Of those, seven human case reports and four animal experiments specifically reported the use of antidotes in poisoning. Human case reports suggested favorable outcomes with IO use of atropine, diazepam, hydroxocobalamin, insulin, lipid emulsion, methylene blue, phentolamine, prothrombin complex concentrate, and sodium bicarbonate. Clinical outcomes varied according to the antidote used. The only reported adverse event was ventricular tachycardia following IO naloxone. Regarding the animal experiments, IO administration of lipid emulsion and of hydroxocobalamin showed improved survival in bupivacaine-poisoned rats and in cyanide-intoxicated swine, respectively. Animal data also suggested an equivalent bio-availability between IO and IV administration for atropine, calcium chloride, dextrose 50%, diazepam, methylene blue, pralidoxime, and sodium bicarbonate. Adverse effect reporting of fat emboli after IO administration of sodium bicarbonate, for example, was conflicting due to the significant heterogeneity in the timing of lung examination across studies.

**Conclusion**
The evidence supporting the use of IO route for the administration of antidotes in a context of poisoning is scarce. The majority of the evidence consists of case reports and animal experiments. Common antidotes such as acetylcysteine, fomepizole, and digoxin-specific antibody fragments have not been studied or reported with the use of the IO route. Despite the low-quality evidence available, IO access is a potential option for antidotal treatments in toxicological resuscitation when IV access is unavailable.

Full text available from: [http://dx.doi.org/10.1080/15563650.2017.1337122](http://dx.doi.org/10.1080/15563650.2017.1337122)

**Adverse events are rare after single-dose montelukast exposures in children**

**Arnold DH, Bowman N, Reiss TF, Hartert TV, Seger DL. Clin Toxicol 2017; online early: doi: 10.1080/15563650.2017.1337123:**

**Study objective**
Montelukast sodium is a leukotriene-receptor antagonist approved as a controller medication for chronic asthma and allergic rhinitis in children and adults. We sought to characterize adverse events associated with single montelukast exposures in children ages 5–17 years and to determine whether adverse events were dose related for all-dose and for ultra-high-dose (≥50 mg) exposures.
**Methods**

This is a retrospective analysis of data from the National Poison Data System for exposures that included montelukast in individuals aged 5–17 years for calendar years 2000–2016. Filters were applied to identify exposure events in which montelukast was the primary exposure and for which the exact or lowest-possible ingested dose was recorded. Characteristics of adverse events were examined using descriptive statistics and multivariable logistic models were used to examine whether associations of montelukast and adverse events were dose related.

**Results**

During the 17-year study period, there were 17,069 montelukast exposures available for analyses. Patients were median [interquartile range] age 7 (5, 9) years, and 10,907 (64%) male gender. Abdominal pain was the most common adverse event (0.23%). There were 618 ultra-high-dose exposures (≥50 mg). These patients had median age 6 (5, 8) years, and 347 (56%) male gender. Abdominal pain was the most common adverse event (1.46%). Increasing ingested dose was associated with abdominal pain (adjusted odds ratio, 1.01, 95% confidence interval 1.01, 1.02) after adjustment for age and gender. No serious or life-threatening events were reported.

**Conclusions**

Single-dose exposures of montelukast up to 445 mg are rarely associated with any adverse events and are not associated with serious or life-threatening adverse events in children aged 5-17 years.

Full text available from: [http://dx.doi.org/10.1080/15563650.2017.1337123](http://dx.doi.org/10.1080/15563650.2017.1337123)

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**Management of severe bupropion poisoning with intravenous lipid emulsion**


**Background**

Bupropion toxicity is characterized by central nervous system and cardiovascular toxicity. Intravenous lipid emulsion (ILE) has been suggested as a treatment by some for the treatment of refractory bupropion toxicity. This recommendation is based largely on published case reports and cases presented at scientific meetings. The objective of this study is to characterize the outcomes of patients with suspected bupropion toxicity in which ILE was administered and the indications for its use.

**Methods**

Electronic records from one regional poison center were searched for intentional bupropion ingestions from 1 January 2009 through 31 December 2015. Cases in which ILE was administered or death was listed as the outcome were further analyzed.

**Results**

There were 1274 cases of suspected bupropion ingestion reported during the study period with 14 reported deaths. Nine cases of ILE administration were identified. Of these, four patients expired and five survived. One of the survivors had neurologic sequelae necessitating placement in a long-term care facility. Patient complications after ILE administration were common and included continued hypotension in 7 cases, recurrent seizures in 3 patients, ARDS in two patients, and renal failure in one patient.

**Conclusions**

The high mortality and complication rate after ILE in this study sample does not reflect the positive outcome benefit seen in previous published case reports. Further characterization of
the efficacy and complications of ILE in bupropion toxicity is needed.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1337909

Self-identification of nonpharmaceutical fentanyl exposure following heroin overdose


**Objective**
To compare user self-identification of nonpharmaceutical fentanyl exposure with confirmatory urine drug testing in emergency department (ED) patients presenting after heroin overdose.

**Methods**
This was a cross-sectional study of adult ED patients who presented after a heroin overdose requiring naloxone administration. Participants provided verbal consent after which they were asked a series of questions regarding their knowledge, attitudes and beliefs toward heroin and nonpharmaceutical fentanyl. Participants also provided urine samples, which were analyzed using liquid chromatography coupled to quadrupole time-of-flight mass spectrometry to identify the presence of fentanyl, heroin metabolites, other clandestine opioids, common pharmaceuticals and drugs of abuse.

**Results**
Thirty participants were enrolled in the study period. Ten participants (33%) had never required naloxone for an overdose in the past, 20 participants (67%) reported recent abstinence, and 12 participants (40%) reported concomitant cocaine use. Naloxone was detected in all urine drug screens. Heroin or its metabolites were detected in almost all samples (93.3%), as were fentanyl (96.7%) and its metabolite, norfentanyl (93.3%). Acetylfentanyl was identified in nine samples (30%) while U-47700 was present in two samples (6.7%). Sixteen participants self-identified fentanyl in their heroin (sensitivity 55%); participants were inconsistent in their qualitative ability to identify fentanyl in heroin.

**Conclusions**
Heroin users presenting to the ED after heroin overdose requiring naloxone are unable to accurately identify the presence of nonpharmaceutical fentanyl in heroin. Additionally, cutting edge drug testing methodologies identified fentanyl exposures in 96.7% of our patients, as well as unexpected clandestine opioids (like acetylfentanyl and U-47700).

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1339889

Non-health care facility medication errors resulting in serious medical outcomes


**Objective**
The objective of this study is to provide an epidemiologic analysis of medication errors occurring outside of health care facilities that result in serious medical outcomes (defined by the National Poison Database System as "moderate effect," "major effect," "death," or "death, indirect report").
Methods
National Poison Database System data from 2000 through 2012 were used for this retrospective analysis of non-health care facility medication errors.

Results
From 2000 through 2012, Poison Control Centers in the United States received data on 67,603 exposures related to unintentional therapeutic pharmaceutical errors that occurred outside of health care facilities that resulted in serious medical outcomes. The overall average rate of these medication errors was 1.73 per 100,000 population, and there was a 100.0% rate increase during the 13-year study period. Medication error frequency and rates increased for all age groups except children younger than 6 years of age. Medical outcome was most commonly reported as moderate effect (93.5%), followed by major effect (5.8%) and death (0.6%). Common types of medication errors included incorrect dose, taking or administering the wrong medication, and inadvertently taking the medication twice. The medication categories most frequently associated with serious outcomes were cardiovascular drugs (20.6%) (primarily beta blockers, calcium antagonists, and clonidine), analgesics (12.0%) (most often opioids and acetaminophen, alone and combination products), and hormones/hormone antagonists (11.0%) (in particular, insulin, and sulfonylurea).

Conclusions
This study analyzed non-health care facility medication errors resulting in serious medical outcomes. The rate of non-health care facility medication errors resulting in serious medical outcomes is increasing, and additional efforts are needed to prevent these errors.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1337908

New legal requirements for submission of product information to poisons centres in EU member states


Introduction
In the past eight years, the European Association of Poisons Centres and Clinical Toxicologists (EAPCCT) has been intensively involved in a European Commission led process to develop EU legislation on the information of hazardous products that companies have to notify to EU Poisons Centres (or equivalent "appointed bodies"). As a result of this process, the Commission adopted Regulation (EU) No 2017/542, amending the CLP Regulation by adding an Annex on harmonised product submission requirements.

Harmonised mixture information requirements
Detailed and consistent information on the composition of the hazardous product will become available to EU Poisons Centres (PC). The information will be submitted by companies to PCs (or equivalent "appointed bodies") using a web-based software application or in-house software. Two new important features are introduced. Firstly, to be able to rapidly identify the product formula, a Unique Formula Identifier (UFI) on the product label links to the submitted information. Secondly, for better comparability of reports on poisonings between EU member states, a harmonised Product Categorisation System will specify the intended use of a product. Rapid product identification and availability of detailed composition information will lead to timely and adequate medical intervention. This may lead to considerable reduction in healthcare costs. Additionally, for companies trading across the EU, costs of submission of this information will be reduced significantly.

Next steps
From 2017, an implementation period has started, consisting of a three-year period for stakeholders to implement the new requirements, followed by a gradual applicability for
consumer products (2020), professional products (2021) and industrial use-only products (2024). Technical tools to generate the electronic format and the UFI together with guidance documents are expected to be made available by the end of 2017 by the European Chemicals Agency (ECHA). Guidance on interpretation of legal text and ECHA helpdesk support are planned to be ready at the end of 2018.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1339888

Occupational chemical exposures: a collaboration between the Georgia Poison Center and the Occupational Safety and Health Administration


Context
In the United States, regional poison centers frequently receive calls about toxic workplace exposures. Most poison centers do not share call details routinely with governmental regulatory agencies. Worker health and safety could be enhanced if regulators such as the Occupational Safety and Health Administration (OSHA) had the ability to investigate these events and prevent similar incidents. With this goal in mind, the Georgia Poison Center (GPC) began referring occupational exposures to OSHA in July 2014.

Methods
GPC began collecting additional employer details when handling occupational exposure calls. When workers granted permission, GPC forwarded call details to the OSHA Regional Office in Atlanta. These referrals enabled OSHA to initiate several investigations. We also analyzed all occupational exposures reported to GPC during the study period to characterize the events, detect violations of OSHA reporting requirements, and identify hazardous scenarios that could form the basis for future OSHA rulemaking or guidance.

Results
GPC was informed about 953 occupational exposures between 1 July, 2014 and 7 January, 2016. Workers were exposed to 217 unique substances, and 70.3% of victims received treatment in a healthcare facility. Hydrogen sulfide was responsible for the largest number of severe clinical effects. GPC obtained permission to refer 89 (9.3%) calls to OSHA. As a result of these referrals, OSHA conducted 39 investigations and cited 15 employers for "serious" violations. OSHA forwarded several other referrals to other regulatory agencies when OSHA did not have jurisdiction. At least one employer failed to comply with OSHA's new rule that mandates reporting of all work-related hospitalizations. This collaboration increased OSHA's awareness of dangerous job tasks including hydrofluoric acid exposure among auto detailers and carbon monoxide poisoning with indoor use of gasoline-powered tools.

Conclusions
Collaboration with the GPC generated a useful source of referrals to OSHA. OSHA investigations led to abatement of existing hazards, and OSHA acquired new knowledge of occupational exposure scenarios.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1338718
Safety profile of snake antivenom (use) in Hong Kong – a review of 191 cases from 2008 to 2015
Mong R, Ng VCH, Tse ML. Clin Toxicol 2017; online early: doi: 10.1080/15563650.2017.1334916:

Introduction
The mainstay of treatment for significant envenoming from snakebites is antivenom. However, there is insufficient data regarding the safety of antivenom used in Hong Kong. We describe the incidence of hypersensitivity reactions from antivenom use and review the frequency and reasons for intensive care unit (ICU) admission.

Methods
The Hong Kong Poisons Information Centre database was reviewed. All patients given snake antivenom between 2008 and 2015 were included. Patient demographics, species of snake involved, details of antivenom used, treatment location, use of pre-treatment, reasons for ICU admission (where applicable) and details of early and late antivenom reactions were extracted.

Results
There were 191 patients who received snake antivenom. Most (93%) were treated with either the green pit viper antivenom from Thailand or the Agkistrodon halys antivenom from China. The incidences of early hypersensitivity reactions to green pit viper antivenom and Agkistrodon Halys antivenom were 4.7% and 1.4%, respectively. Most patients (69%) were managed in the ED observation ward or general ward. There were 59 patients managed in ICU, most (90%) of whom were admitted for close monitoring during antivenom administration. There were no cases of significant morbidity from antivenom administration. Eight patients (5.6%) had features suggestive of mild serum sickness.

Conclusions
The incidence of immediate hypersensitivity reaction to antivenom commonly used in Hong Kong is low. Majority of patients were managed safely in the emergency department observation ward or general ward. Serum sickness appears to be uncommon and possible cases presented with mild features.

Full text available from: http://dx.doi.org/10.1080/15563650.2017.1334916

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Thallium

CHEMICAL WARFARE, BIOLOGICAL WARFARE AND RIOT CONTROL AGENTS
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