Opioid crisis: Challenging times for toxicology laboratories

The BC Provincial Toxicology Centre (PTC) performs extensive clinical toxicology testing, which includes screening for drugs of abuse and therapeutic drug monitoring for medications with narrow therapeutic indices. The PTC also helps with death investigations by providing forensic toxicology testing and interpretation to the BC Coroners Service.

Substance abuse is a serious problem with extensive social and economic burdens. The ongoing opioid crisis has reached epidemic proportions, with drug overdose deaths continuing to increase. The scale of the problem is stressing first responders, law enforcement, and health care resources to their limit.

Alcohol, marijuana, cocaine, methamphetamine, ecstasy, and opiates are the most commonly abused substances. With the Canadian population being so culturally diverse, substances such as hash, opium, khat, and kratom can also be present. In addition, there is a growing problem with prescription drugs being diverted for illicit purposes. The situation is further complicated by the rapid emergence of novel psychoactive substances that are cheap, easy to obtain, and deadly.

Previously, toxicology laboratories employed rather narrow test menus. Only occasionally did they have to expand their capabilities to detect new substances, with notable examples being lysergic acid diethylamide (LSD), heroin, and gamma-hydroxybutyrate (GHB).

With the rise of globalization and the explosive growth of the flow of information, the drug scene has changed dramatically, first with the appearance of synthetic cannabinoids in the early 2000s and then with the emergence of hundreds of other "designer" drugs. These synthetic cannabinoids ("spice"), cathinones ("bath salts"), benzodiazepines, and opioids often have greater potency than original analogs and are designed to circumvent regulation and detection. Fentanyl analogs such as acetylfentanyl, carfentanil, and others have no licensed medical use but have much greater potency, leading to life-threatening respiratory depression at very small doses.[1] Fentanyl and derivatives are now found in mixtures sold in underground markets as heroin, cocaine, or under other names, and can kill an unsuspecting drug user. Toxicology laboratories now confront the challenge of detecting drugs that may be present in blood at low concentrations and for short periods of time. The chemical structures of these drugs may be unknown, and labs may face a lack of knowledge about their metabolites and an absence of reference standards.

The ongoing crisis places a significant burden on the PTC. The laboratory consistently observes increased workloads due to receiving a growing number of cases with amplified complexity. In 2017, the PTC received 20% more death investigation cases than in 2016, when the laboratory saw a whopping 33% increase compared with 2015. Furthermore, investigations are complicated by the presence of novel synthetic drugs that are difficult to detect using available technology. With this influx of novel substances and ever-changing drugs of choice, toxicology laboratories such as ours are increasingly unaware of what they might find in samples and may lack the tools necessary for their detection.

As a result, the PTC is forced to use strategies to help it adapt quickly. These include participating in toxicovigilance programs to guide the development of new detection methods. Resources to support assay development must be available together with efficient workflows, which can be achieved through automation of sample preparations and liquid handling, and the use of laboratory information systems. Most critical is the availability of analyzers using advanced technology. Liquid chromatography tandem mass spectrometry is a powerful method but requires mass spectra information that is often unavailable for emerging drugs. High-resolution accurate-mass spectrometry, with more sophisticated time-of-flight and Orbitrap technologies, distinguishes molecules that are different by as low as 0.001 atomic mass units (amu), compared to 1 amu for conventional instruments, and allows for detection and identification of compounds with unknown structures.[2] This powerful system will be available in our laboratory, and when used in untargeted screening mode will enable us to detect emerging drugs using practical workflows.

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References

1. Frank RG, Pollack HA. Addressing the fentanyl threat to public health. N Engl J Med 2017;376:605-607.
2. Wu AH, Gerona R, Armenian P, et al. Role of liquid chromatography-high-resolution mass spectrometry (LC-HR/MS) in clinical toxicology. Clin Toxicol (Phila) 2012;50:733-742.