ABSTRACT

Proactive NPS Surveillance in the United States DEA TOX Program

The rapid molecular evolution of multiple classes of new psychoactive substances (NPS) in the last decade posed an unprecedented challenge to drug testing in clinical and forensic laboratories, and forced a paradigm shift in drug testing. The recognition of suspect screening as an important part of NPS discovery in clinical and forensic cases underscored the utility of high-resolution mass spectrometry (HRMS) in drug testing. A few laboratories including ours have demonstrated the value of NPS identification through HRMS in surveillance programs and mass outbreak resolutions as well as in informing policies and legislative oversight in drug scheduling.

To respond to the ongoing public threat of NPS in the United States, the US Drug Enforcement Administration launched its DEA TOX program in 2019. DEA TOX is a nationwide NPS surveillance program that offers free comprehensive drug testing on cases that may have NPS etiology. The program accepts blood and urine sample for NPS, drugs of abuse, and prescription drug testing, the results of which are reported back to referring institutions and collated in quarterly reports. Our laboratory supports DEA TOX using liquid chromatography- quadrupole time-of-flight mass spectrometry (LC-QTOF/MS) testing.

Even HRMS-mediated drug testing remains reactionary to the whims and stratagems of clandestine laboratories driving the swift changes in the molecular identities of NPS. Thus, outwitting NPS manufacturers require a strategy that goes beyond drug testing. Proactive drug surveillance that relies on linking drug testing with proactive synthesis and pharmacological characterization of anticipated NPS is a strategy that may effectively respond to the decade-long NPS epidemic. This strategy is implemented though a wide, collaborative network of experts from a variety of disciplines besides analytical toxicology. In a mutualistic collaboration, the network pools expertise and efforts from basic science researchers who use surveillance data to unveil trends in the evolution of NPS structures, and forecast, synthesize and characterize anticipated NPS molecular targets. The data and standards produced by the network's basic scientists are then incorporated into drug testing to facilitate rapid NPS identification and confirmation in clinical and forensic cases.

My talk will discuss the workflow we are using for proactive NPS surveillance and its utility to the US DEA TOX program. Since the program resumed in October 2020 after the height of COVID-19 pandemic, the program has processed more than 370 cases and is continuing to receive between 30-60 cases each month. Results of the surveillance between October 2020 and October 2021 will also be presented.

ABSTRACT

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在過去十年中，多種新興濫用物質 (new psychoactive substances , NPS) 的快速分子進化對臨床和法醫實驗室的藥物檢測帶來了前所未有的挑戰，並迫使藥物檢測的模式轉變。在臨床和法醫案例中篩檢新興濫用物質是很重要的，因此也凸顯了高解析質譜分析儀 (high-resolution mass spectrometry, HRMS)在藥物檢測中的應用。包括我們在內的一些實驗室已經證實了在監控計畫中高解析質譜分析儀具有多種價值，如可利用高解析質譜分析儀辨識新興濫用物質，同時其也作為處理大量案件的有效方法，以及訂定用藥計劃的政策和立法監督方面。

為了應對新興濫用物質對美國公眾持續存在的威脅，美國緝毒局於 2019 年啟動了DEA TOX計劃(DEA toxicology testing program)。DEA TOX是一項全國性的新興濫用物質監測計劃，為可能是新興濫用物質濫用的病例提供免費的全面藥物檢測。該計劃受檢懷疑濫用新興藥物、其他濫用藥物和處方藥物的血液和尿液樣本，其結果將回報給轉診院所，並在季度報告中進行核對。我們使用液相層析四極柱串聯時間飛行式質譜儀 (LC-QTOF/MS)進行DEA TOX的檢測。

即使是使用高解析質譜分析儀檢測藥物，仍無法追趕上那些非法實驗室所製造分子特性迅速變化的新興濫用物質，因此，智取新興濫用物質製造商需要一種超越藥物檢測的策略。前瞻性藥物監測是依靠著連結藥物檢測，與預期新興濫用物質的前瞻性合成和藥理學表徵作為檢測，這可能是一種有效應對長達十年新興濫用物質流行的策略。除了分析毒理學外，該策略攏絡了來自各學科的專家們的合作網絡來進行。在互惠合作中，該網絡匯集了基礎科學研究人員的專業知識和努力，他們使用監測數據推測出新興濫用物質結構演變的趨勢，並預測、合成和分類出預期的新興濫用物質分子結構標的。然後，專家們所推算出的數據和分子結構隨後被納入藥物檢測，以促進在臨床和法醫案例中快速辨識和確認新興濫用物質。

本次主題將討論我們執行前瞻性新興濫用物質監測的工作流程，及其對美國DEA TOX計劃的效用 。此計劃在 COVID-19 大流行高峰後，於2020年10月恢復以來，已處理了370 多件案例，並且每月持續接收30-60個案例。本此將還會分享自2020年10月至 2021年 10月期間的監測結果。