Development and Validation of a Quantitative GC-MS Method to Analyze Fentanyl-Containing 'Dope' Samples with One-Step Liquid Extraction

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Learning Overview: After attending this presentation, attendees will be able to describe the design, validation, and implementation of a multi-component quantitative assay for solids and powders suspected to contain fentanyl. Through their attendance, the audience will be able to explain quantitative drug methods, parameters to include in their validation, some applications, and what challenges to anticipate during development.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by describing a novel, multi-component assay to quantitatively analyze drug material. Benefits to the forensic community are support for public health initiatives, medicolegal death investigations, and prosecutions based on the purity of drugs found on overdose victims. The method also supports forensic investigations involving sample comparisons, and intelligence on sample profiling.

Keywords: Fentanyl, Quantitation, GC-MS

Abstract:

Illicit fentanyl is the primary contributor or co-contributor to overdoses and overdose deaths in the United States. However, purity of drugs in exhibits in criminal casework are rarely determined, inhibiting investigations of drug overdoses, and adverse event outbreak investigations. Moreover, the drug supply in the United States has entered a "poly-drug" phase where drugs (especially opioids) are found in combination with other substances of varying pharmacological activity. For example, in Philadelphia, fentanyl is the primary opioid in "tranq-dope" samples which are largely adulterated with xylazine, a non-controlled animal tranquilizer not intended for use in humans.

For this study drug material samples were collected for qualitative and quantitative analysis by the Philadelphia Department of Public Health. Analysis was performed at the CFSRE by gas chromatography mass spectrometry (GC-MS) and liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QTOF-MS). This presentation will describe the development and validation of the GC-MS method for the measurement of fentanyl, xylazine, 4-ANPP, para-fluorofentanyl, methamphetamine, cocaine, levamisole, and lidocaine. Methamphetamine and cocaine were included in the assay so that they could be measured if found in combination with fentanyl. This presentation will describe the method, its design, the validation plan, the validation results, and application to authentic samples.

A single-step, basic drug extraction was selected due to superior chromatography compared to methanol dilution, yet still providing an efficient workflow for measuring the selected analytes and identifying other basic drugs. Validation was performed over five days and included evaluation of calibration model, accuracy, precision, carryover, limit of detection, dilution integrity, recovery, process efficiency, and matrix effects. The method was successfully validated based on the 2019 SWGDRUG recommendations for validating analytical methods and ASB recommendations for validating quantitative toxicology methods. Initial results show that mean fentanyl purity in powder was 11.5% (interquartile range = 8.2 – 15.2%, n = 58), 4-ANPP had a mean concentration of 2.2% (interquartile range from 1.0 – 2.7%, n = 54), and xylazine being a major component with a mean of 31.8% (interquartile range from 21.6 – 41.3%, n = 52).

Timely data on street drug potency allows public health agencies to decide how best to communicate vital information concerning drug purity, potency, and combinations to prevent overdoses and promote harm reduction. Potency data and the concentrations of adulterants and reaction intermediaries and by products can allow development of drug signatures, allowing comparisons of drug exhibits from different seizures for assessment of common origin, consistency of the contents of different “stamps”, or temporal changes in drug potency in the street drug supply.