E50 Attacking the Epidemic: Methods and Considerations for Detection of Fentanyls and Novel Psychoactive Substances (NPS) by Thermal Desorption Direct Analysis in Real-Time Mass Spectrometry (DART®-MS)

Edward Sisco, MS, NIST, 100 Bureau Drive, MS 6431, Gaithersburg, MD 20899*

After attending this presentation, attendees will have a better understanding of the strengths, limitations, and safety concerns of employing ambient ionization MS techniques, such as DART®-MS, to the screening of evidence for fentanyl, fentanyl analogues, and other NPS. Attendees will be presented with typical spectral signatures for these compounds, instrument optimization parameters to consider, methods for identifying the limitations posed by competitive ionization (to minimize missed detections), and considerations for analyst safety.

This presentation will impact the forensic science community by providing necessary information for the implementation, strengths, and weaknesses of ambient ionization MS techniques, such as DART®-MS, for the analyses of hazardous chemicals, such as fentanyl.

The increasing prevalence of fentanyl, fentanyl analogues, and other NPS in the community poses significant challenges to law enforcement, first responders, and forensic practitioners. Because of the significant hazards these compounds present, current methods of presumptive screening may no longer be practical. Methods such as color tests that require visible amounts of material have been deemed too dangerous by some agencies (due to inhalation exposure hazards), leaving a gap in the typical analysis chain.

One technique that may fill this gap is Ambient Ionization-MS (AI-MS). These instruments, namely DART®-MS, are being increasingly employed in forensic casework because of their ease of use, minimal sample preparation, and speed of analysis. While these instruments are not ready for deployment into the back of a police cruiser or crime scene van, they have been critical in providing rapid presumptive analyses in forensic labs.

While DART®-MS and other AI-MS techniques show promise as rapid screening tools, the manner in which sampling is commonly completed poses potential risks to examiners. Inhalation of aerosolized samples and the potential for contamination of the instrument are distinct possibilities with techniques such as DART®-MS. This study will address measures that can be taken to limit exposure of the analyst and minimize contamination of the surfaces, providing a safer means of analysis.

This study focuses on identifying the capabilities of Thermal Desorption (TD) -DART-MS, an ambient ionization MS technique, for the detection of fentanyl, fentanyl analogues, and other NPS. More than 20 fentanyl analogues and 25 additional NPS were studied. Using pure compounds and a design-of-experiments approach, a method was created to evaluate analytical metrics of the technique. As observed with many other narcotics, protonated molecular ions are the predominant ions formed, and limits of detection are commonly in the tens to hundreds of picograms. Additionally, considerations for the detection of realistic samples, which commonly exist as multi-component mixtures, will be discussed. Since real-world samples commonly consist of multiple components (i.e., multiple drugs, analogues, and cutting agents), it is necessary to understand how the presence of these compounds will affect detection of the target compounds, given their small weight percentages. Using a combination of prepared and street samples, the limitations of TD-DART®-MS in detection of these minor components and as potential scenarios when detection may not be possible (false negatives) will be presented. Work toward creating a library of these compounds based on representative spectra will also be discussed.

Fentanyl, DART®-MS, Drug Analysis

*Presenting Author