E62 Rapid, Real-Time, and In-Field Detection of Fentanyl Residue: A New Approach Using Ion Mobility Spectrometry (IMS)

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Learning Overview: After attending this presentation, attendees will understand a new technology to detect fentanyl residue (<10ng) in a rapid (<5 seconds), real-time (instant peak display), and in-field (a portable device) manner.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a cutting-edge method of detecting opioid-fentanyl-based drugs in the field. Attendees will learn how the IMS is capable of displaying the detection results in less than five seconds and also related testing procedures, which may have a strong implication for law enforcement and public health agencies in addressing the current fentanyl crisis worldwide.

Currently, it is argued that opioid-fentanyl is the number one enemy in the opioid crisis and costs thousands of lives each year in the United States. Due to fentanyl's potent nature, law enforcement and public health agencies need a portable technology to determine its existence in certain situations, such as crime scenes, dead bodies, mail parcels, and/or abandoned drug apparatus. A new portable technology is based on the principle of IMS, weighs only 5kg, and can provide a real-time detection result on fentanyl residue in less than five seconds in field tests. Further, the technology can be connected to a Wi-Fi system for a remote communication. Finally, the IMS system has nine unique functions similar to the capacities of a Mass Spectrometry(MS) system.

With a quasi-experimental study by black box sampling, two spots on a school backpack were located for testing purposes: one spot ($1mm^2$) was dipped with a drop of fentanyl (medical use) by a syringe, and the other spot ($1mm^2$) with a drop of water. Two glean wipes on both spots using two separate swabs (a special material) were inserted into the machine inlet slot. The device was able to provide both readings within five seconds with accurate results. The system's internal cleaning process between two tests takes about 30 seconds. Therefore, the two consecutive tests require just under one minute on an area of less than $1mm^2$ for less than ten Nano-grams of fentanyl in concentration under a normal atmosphere condition.

This IMS system consists of two parts: (1) the compounds that are used in testing must be ionized to become ions; (2) the ions pass through an electrical field so that different types of ions will be separated by the size, charge, and mass of the compounds. It is similar to the MS method except that IMS is a portable system and does not require a vacuum. The detection happens in a normal atmospheric environment so that it is relatively less expensive and easily made as a portable detector in the field. In fact, its detection sensitivity may reach the one Nano-gram level, depending on the types of fentanyl tested, which is quite adequate for detecting fentanyl variations on international and domestic parcels in real-life postal inspections. One of the special features of this technology is its use of Very Deep Ultra-Violet (VDUV) photons to ionize the sample, instead of a traditional radioactive ionization source, such as Ni63 isotope material. Therefore, it is non-radioactive and thus very safe to operate in the field. Finally, the drift time *t* can also be deducted into a *k0* parameter, which is the universal constant for each individual compound (*k0* is a physical parameter determined by the physical nature of the molecule/ion).

This study hypothesizes that a rapid, real-time, and in-field determination of fentanyl is one of the technical challenges in fighting the current fentanyl crisis in the United States. From this study, it is concluded that the application of the IMS is able to provide a practical method at the scene, in the lab, or even during courtroom testimony. This study strongly contends that the study results add a new effective approach for law enforcement and public health agencies. It is believed that if such technology can be utilized as a common practice, our duties and performance in addressing the fentanyl crisis will certainly be advanced from the past toward a more science-based future.

Fentanyl Detection, Ion Mobility Spectrometry (IMS), Forensic Toxicology/Chemistry

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