



DHS SCIENCE AND TECHNOLOGY

Combating Opioid Smuggling *CBP-ADEPT Workshop 2*

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**Homeland
Security**

Science and Technology

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Mission Capability Support

Science and Technology Directorate

WANTED: Technologies to Stop Opioids Smuggled in the Mail

- **Mission:** Secure America's borders from the illicit entry of dangerous materials without impeding legitimate trade and commerce
 - *Prohibited item(s): Narcotics and other chemicals of concern*
 - *Entry: Focus on international mail*
- **Problems needing solutions**
 - *Ability to detect small quantities of synthetic opioids (e.g., fentanyl) amongst large volumes of mail*
 - *Confidence in high-throughput, non-intrusive methods*
 - *High probability of detection (PD), low probability of false alarm (PFA)*
- **S&T is collaborating with CPB**—and invite others to work with us
 - *LRBAA SEC-BORD 04-02 and be on the lookout for other BAA opportunities*
 - *CRADAs*



Fentanyl in the News
Source: www.theshoestring.org



Ready for shipment
Source: CBC News Interactive

The operational challenge: in two pictures



JFK International Mail Facility



Lethal dose of heroin, fentanyl, and carfentanil

Source: New Hampshire State Police Forensic Lab

External Features of Packages

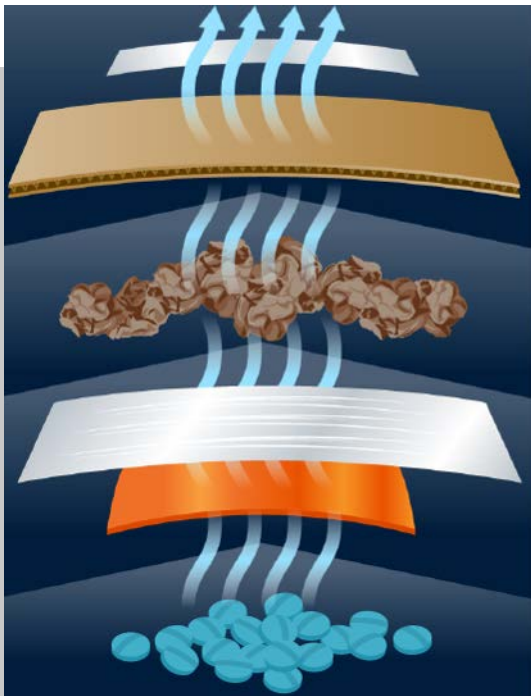
- There may be **indicators** of a suspicious package/parcel, such as:
 - *Handwriting*
 - *Labels or other markings*
 - *Packaging materials/methods*
- *Status:*
 - S&T collected images of packages referred to CBP for inspection
- *Next:*
 - Engage academic and industry partners to **apply deep learning methods** to evaluate the feasibility of using these data to flag/sort packages
- For operational relevance, requires automated capture of data



Staged International Package

External Chemical Signatures

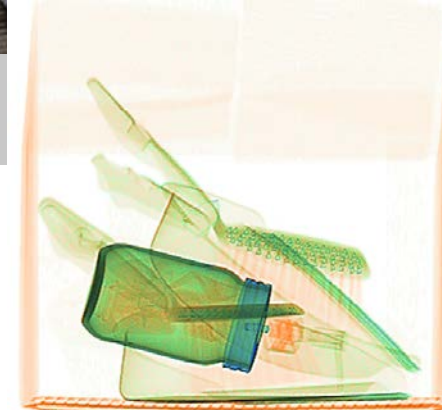
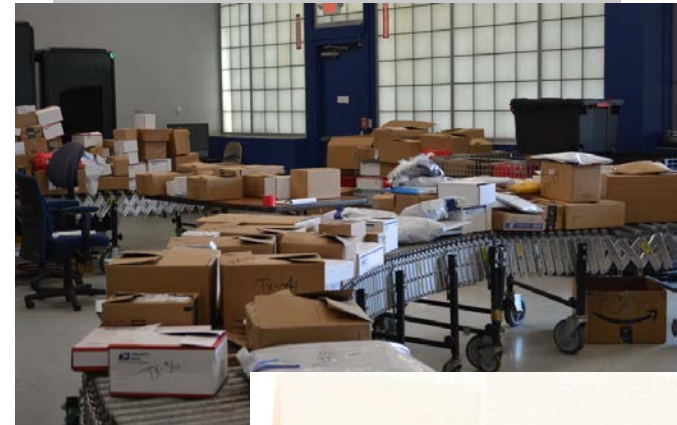
- Potential to use **trace particulates/residues** found on surface or escaped **vapor**
- Need to understand what is detectable to set requirements for detection



- *Status:*
 - Developed modeling tool to quickly assess **measurable vapor signature** in different operational scenarios (Battelle)
 - Ongoing collection and analysis of samples from surfaces in operational facilities (NIST)
- *Next:*
 - Preliminary results indicate little to no contamination—confirm **detectable surface residue over background**
 - Explore feasibility of standoff **optical trace** detection (IARPA)
- In addition to scientific questions, need to consider CONOPS

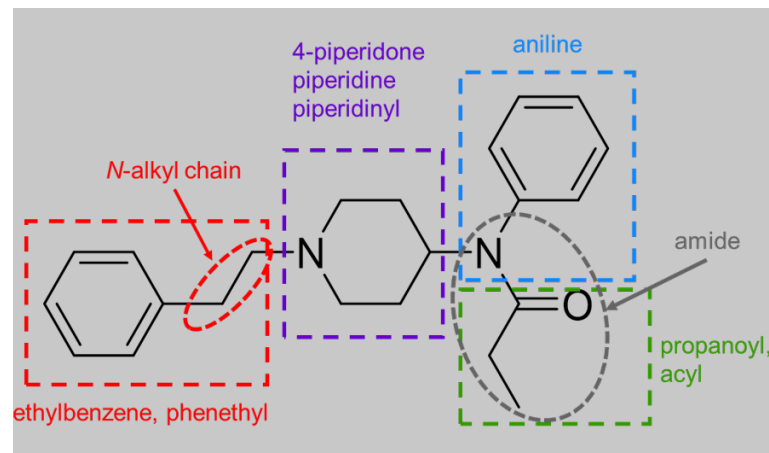
Image Analysis of Contents

- Improve current inspection process through next gen **X-ray** systems or **computed tomography (CT)**
- Assist operators or **automate anomaly detection** through algorithm
- Through partnership with S&T **Transportation Security Laboratory (TSL)**
- *Status:*
 - Developed simulants and verified against data from seized fentanyl(s)
 - Developed test objects that replicate stream of commerce and threat items
 - Collected dual-view x-ray data for algorithm development
- *Next:*
 - Collect and provide CT data to OEMs to facilitate spiral development of detection algorithms for synthetic opioids



Non-intrusive chemical detection

- Use of technologies to conduct **through-barrier** determination of **molecular signatures** for identification, such as:
 - Nuclear Quadrupole Resonance (NQR), X-ray diffraction (XRD), Short-wave Infrared (SWIR) Hyperspectral Imaging
- *Status:*
 - Conducted technology foraging and assessment (S&T Chemical Security Analysis Center)
 - Advanced 8 Finalists to Stage 2 Prototyping Accelerator in the **Opioid Detection Challenge**, international, open-innovation prize competition
- *Next:*
 - Test and evaluation of finalists solutions
- **Variability in opioid structures** may challenge library development and rapid adaptability



Opioid Detection Challenge Finalists

- **Dynaxion (Netherlands):** Neutron-based scanning system that uses novel Radio Frequency Quadrupole (RFQ) technology developed by CERN
- **Battelle (US):** Machine learning algorithms applied to images captured through dual-energy radiography and hyperspectral imaging
- **HALO X-ray Technologies:** X-ray diffraction technology that emits X-rays in a conical structure
- **One Resonance (US):** Quadrupole resonance technology that uses radio-frequency signals
- **GTBM, Inc. (US):** Ultrasound technology that transmits sound waves and analyzes the returned frequencies to define the distinct atomic/molecular signature of the target
- **Vadum, Inc. (US):** A nuclear quadrupole resonance (NQR) technology that emits radio-frequency pulses
- **XID, LLC (US):** An energy dispersive X-ray diffraction (EDXRD) technology that uses a polychromatic beam
- **IDSS Holdings (US):** Combines a 3D X-ray computed tomography (CT) scanner with automated detection algorithms based on the scanned item's features and physical properties

Next steps and other work

- Complete analyses to:
 - Evaluate efficiency and feasibility of different sampling methods for detection of concealed opioids in an operational environment
 - Validate source term models by measuring vapor and particulate signatures across representative scenarios
- Complete a systems analysis to develop system architecture and process models
- Invest in development down-selected technology options
 - Developmental test and evaluation (T&E)
 - In partnership with CBP, conduct operational assessment
- T&E of portable/handheld technologies and development of consensus standards and methods



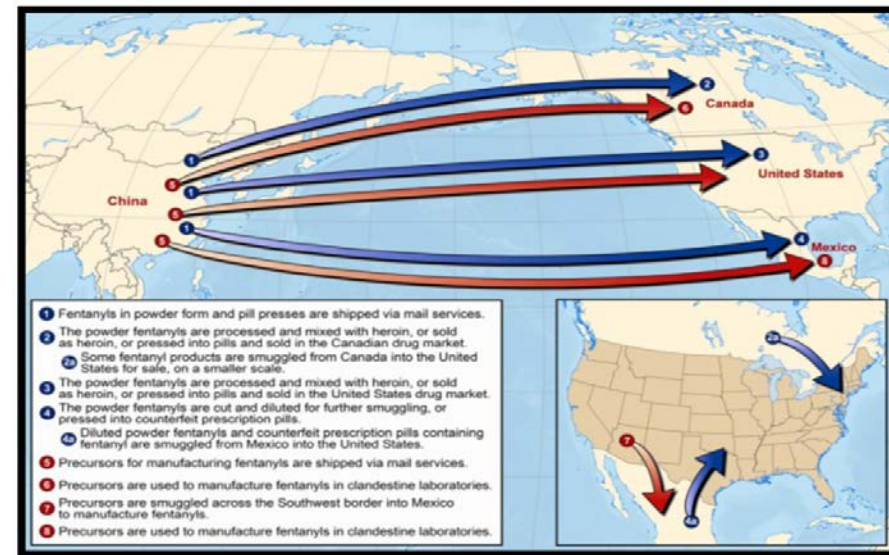
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DIVERSE PERSPECTIVES + SHARED GOALS = POWERFUL SOLUTIONS

Importation of synthetic opioids

- Importation of synthetic opioids presents a major **law enforcement challenge**
- Most synthetic opioids (~90%), like fentanyl, are made illicitly in China
 - One kilogram of fentanyl from China costs ~\$3,000 to \$5,000 and can generate **over \$1.5 million** in revenue through illicit sales in the U.S.
 - Drug trafficking organizations are “cutting” other drugs, like heroin and cocaine, with fentanyl to maximize profits
- Two primary ways to smuggle into the US:
 - Ports of entry such as land border crossings, cargo ports, and airports
 - International mail, via express consignment (private) carriers or the U.S. Postal Service



Source: DEA Fentanyl Briefing Guide for First Responders

S&T Synthetic Opioid Detection at Speed (SODaS)

Operational Need

- Executive Order 13784 declared fentanyl/opioid detection a **major priority**; and a critical element of the White House multi-pronged opioid strategy includes “efforts to detect and intercept illicit drugs coming across our borders”
- CBP needs capabilities to better detect and interdict synthetic opioids entering the US, including at facilities handling international mail and express consignment.
- The Program will help fulfill requirements established by the INTERDICT Act and STOP Act of 2018.

Program Goals

- The program goal is to advance capabilities to detect and interdict synthetic opioids by identifying and developing 1) process improvements, 2) analytics, and 3) technologies that enable more packages to be screened at the speed of commerce and more effective and efficient targeted inspection of those packages suspected of containing synthetic opioids, and improved safety.

Impact

- Outputs from this program will enhance CBP’s ability to detect synthetic opioids throughout the mail flow process, as well as create operational efficiencies and support the complete interdiction mission.
- This program helps an overall goal to increase the number of seizures/interdictions of synthetic opioids, like fentanyl, in small quantities, thereby reducing the overall supply of drugs entering the US.

Technical Aspects

- S&T Program will address the following technical needs:
 - *Ability to detect small quantities of synthetic opioids (e.g., fentanyl)*
 - *Ability to identify the variety of opioid analogues in the field/onsite*
 - *Confidence in high-throughput, non-intrusive methods*
 - *Increased probability of detection (P_d), decreased probability of false alarms (P_{fa})*
 - *Reduced manpower, time, and cost associated with inspection process*
 - *Detection standards*
 - *Supply chain analytics for improved targeting*

Informed by Science

- What should be detected?
 - Develop an opioid data repository and threat basis to support detection and medical research priorities
 - Map the current synthetic opioid problem space to identify inspection and detection process options and inform the development of capability requirements
- What can be detected?
 - Determine the quantities and chemical signatures associated with the concealment of illicit drug materials and in operational environments
- How well does existing equipment detect opioids?
 - Lab-based and field-based performance evaluations (T&E)
 - Development of standard methodologies and safe surrogates

