





Forensic Toxicology in a Public Health Lab

Amy Miles
Director of Forensic Toxicology
WI State Lab of Hygiene
National Resource Toxicologist
amy.miles@slh.wisc.edu



Wisconsin State
Laboratory of Hygiene
UNIVERSITY OF WISCONSIN-MADISON

Overview For Current Drug Trends



- Forensic Toxicology Overview
- Novel Psychoactive Substances
 - THC isomers
 - Opioids/stimulants
 - Kratom



WSLH



- Public Health Laboratory for the State of WI
 - PT program, CDD, NBS, Environmental testing, Chemical Emergency Response
- Forensic Toxicology
 - 22 staff
 - Receive 20,000+ samples each year
 - Perform drug testing on ~10,000
 - Combination of impaired driving and Medical Examiner casework
- Maintain focus on public health

What is Forensic Toxicology?



- The use of toxicology (analytical chemistry, pharmacology and clinical chemistry) to aid medical or legal investigations
- Forensic Toxicology *does not measure impairment*



Testing Matrices



- Blood - majority
 - Give picture of what person is currently under influence of
 - Serum vs plasma vs blood
- Urine – history lesson
 - Can tell past use
 - Subject to dilution/adulteration
- Oral Fluid
 - Up and coming matrix for roadside
 - Several oral fluid studies across the US and Canada
- Clinical vs Forensic



Testing Workflow



- Blood Alcohol Test
- Screen by QToF
- Confirmation and quantitation
- Report results
- Interpret results
- Testify in court





It's Not Always Just Alcohol



THC	Bupropion
Methamphetamine/amphet	Quetiapine
Fentanyl	Fluoxetine
Cocaine/BE	Clonazepam
Gabapentin	Methadone
Beta-hydroxyfentanyl	Oxycodone
Diphenhydramine	Metonitazene
Alprazolam	Lamotrigine
Citalopram	Buprenorphine
Trazodone	Sertraline

Most common drug trend...



Tracking the Trends



- <https://www.npsdiscovery.org/>

The screenshot displays the website for NPS Discovery. At the top, there is a navigation bar with links for 'About Us', 'Newsroom', and 'Contact Us'. Below this is the CFSRE logo, which includes the text 'cfsre' and 'Center for Forensic Science Research and Education'. A search bar is also present. The main content area features a large image of a person in a lab coat and gloves working with laboratory equipment. Below the image, the text reads: 'NPS Discovery' followed by a paragraph: 'The Center for Forensic Science Research and Education (CFSRE) is working in collaboration with law enforcement, public health, and public safety agencies to rapidly identify emerging drugs, also known as Novel Psychoactive Substances (NPS), associated with intoxications and adverse events. The information, reports, and resources consolidated here by CFSRE allows for the rapid dissemination of information to stakeholders and affected communities.' A second paragraph follows: 'CFSRE would like to acknowledge its collaborative NPS partners, including NMS Labs, Temple University, the Organized Crime Drug Enforcement Task Force (OCDETF) of the Department of Justice, and the National Institute of Justice (NIJ) of the Department of Justice, as well as our technical collaborative partners SCEX and Waters Corporation.' At the bottom, there is a 'Reports' section with a small image of laboratory equipment.

Novel Psychoactive Substances (NPS)

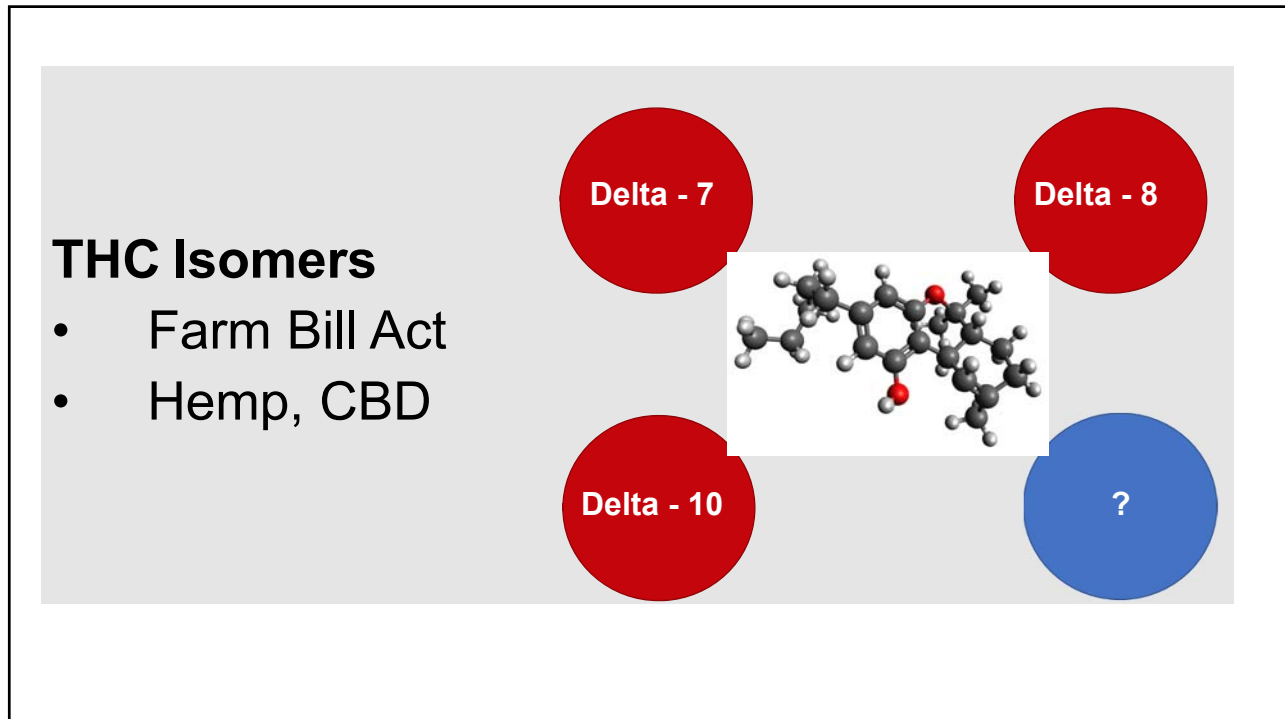
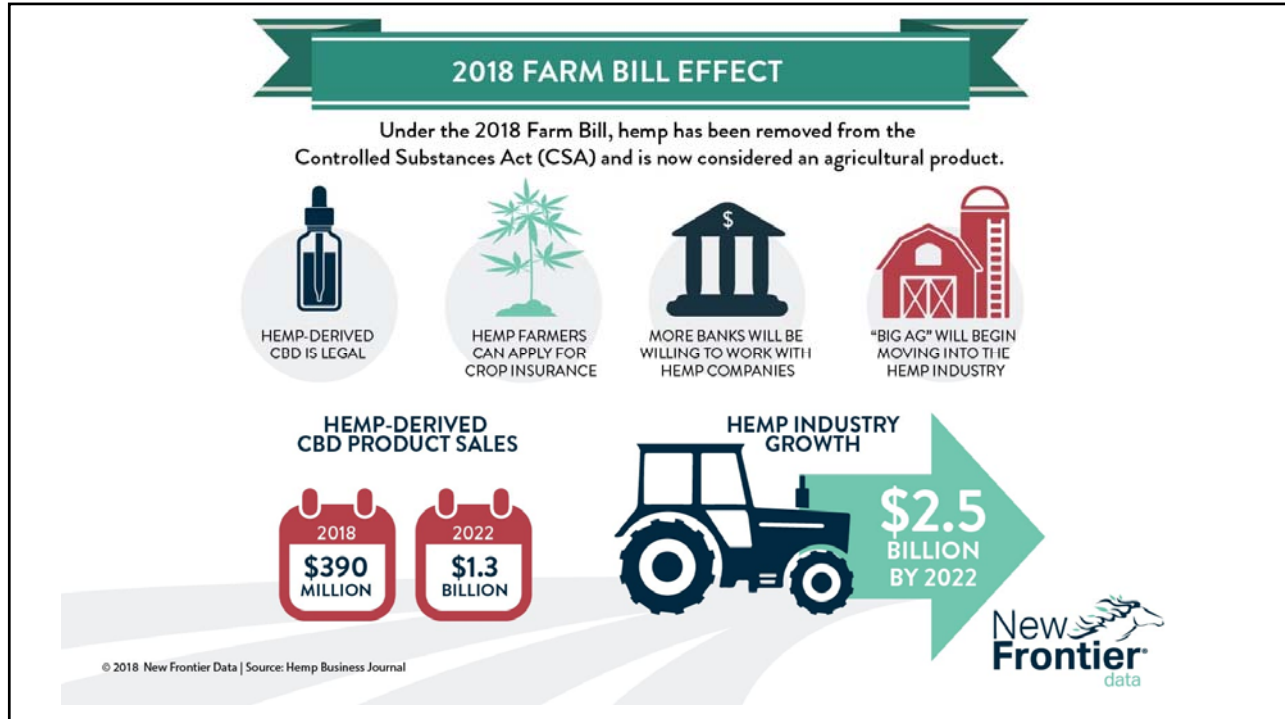


NPS Challenges in Forensic Testing



- New drug “revolving door”
- Instrumentation
- Training
- Partnerships





CBD and Hemp are NOT THC



- Legal CBD and Hemp products are to contain less than 0.3% of THC
 - Truly legal products will not create a detectable amount of delta-9-THC in blood
- Law enforcement field test kits
 - May be able to distinguish between CBD and THC
 - Laboratory testing required
- Zero regulation/oversight of products
- Potential for adverse, drug-drug interactions

CBD Does Not Convert to Δ 9-THC



Review

Conversion of Cannabidiol (CBD) into Psychotropic Cannabinoids Including Tetrahydrocannabinol (THC): A Controversy in the Scientific Literature

Patricia Golombek [†], Marco Müller [‡], Ines Barthlott, Constanze Sproll and Dirk W. Lachenmeier ^{*@}

- End conclusion – CBD does not convert into any of the major compounds measured in forensic testing
 - Δ 9-THC, 11-OH, COOH

CBD



- No scientific evidence of medicinal efficacy
 - Exception: Epidiolex – oral solution for the treatment of seizures associated with Lennox-Gastaut syndrome and Dravet syndrome
- Evidence of liver injury
- Polysubstance effects unknown
- CBD + CNS dep = increased risk of sedation and drowsiness



CBD and Other Product Risks



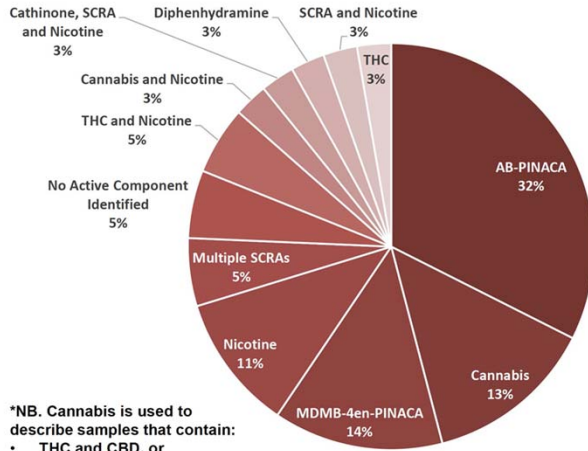
- Product risk
 - Unknown side effects with concomitant drugs
 - Claims of product QA and testing
 - Other drugs likely present in product
 - Concentration of THC varies



Zero Regulation = Unknown Products



THC E-Liquid submissions February 2021

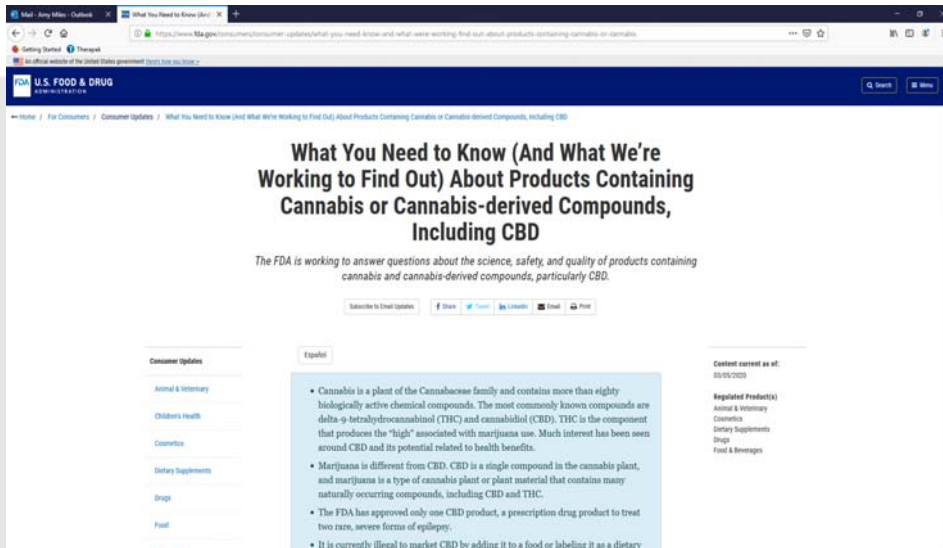


37 samples submitted as THC E-Liquids

Age range of sample providers: 16 to 40 years

Median age of sample providers: 25yrs

*NB. Cannabis is used to describe samples that contain:
 • THC and CBD, or
 • THC and CBN, or

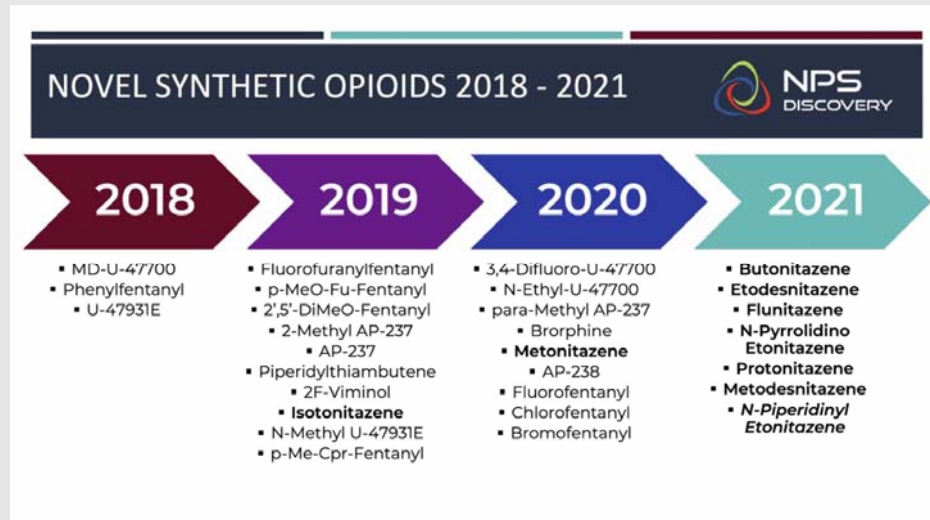


<https://www.fda.gov/consumers/consumer-updates>

NPS Challenges



- Novel opioids
 - Fentanyl, fentanyl analogs



Isotonitazene Milwaukee Case



- Witness finds car with 2 occupants, both appear “passed out”
- Driver was disoriented, slurred speech, droopy eyelids
- Constricted pupils, no change or reaction to light
- Shallow breathing, complained of exhaustion when only taking a few steps

Isotonitazene



- QToF testing detected the isotonitazene
- Synthetic opioid that is similar to a controlled opioid, etonitazene
- Little scientific information on this drug but suggested greater potency than fentanyl
- Several fatal OD cases in the US
- Casework in WI: always in combination with synthetic benzos
 - Three crashes in different areas of the state

The “New” Speedball



- Methamphetamine + novel opioid





Kratom



- Mitragynine and 7-hydroxymitragynine (7-OH-MG)
- Tree native to Southeast Asia
- Used as an herbal drug
 - Low doses – stimulant
 - High doses – sedative
- Commonly used to self-treat opioid addiction



Kratom Dosing

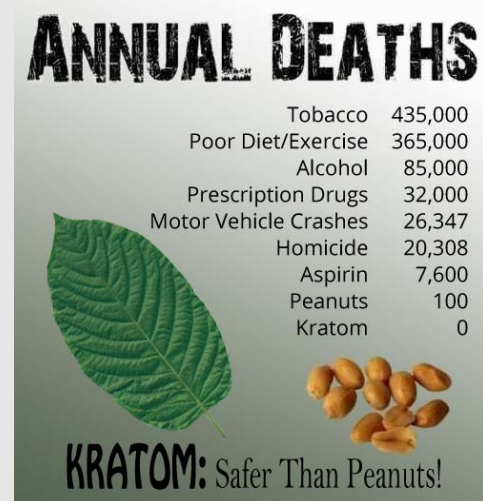


Dosage (Kratom leaves, not extracts)	Effects
2-6 grams	Mild - stimulant
7-15 grams	Stimulant, crossing over to sedative/euphoric/analgesic
16-25 grams	Sedation and euphoria ("too strong for highly sensitive people")
26-50 grams	Strong sedation and euphoria ("TOO STRONG FOR MOST PEOPLE")

Kratom



- Pharmacology
 - Opioid receptor binding
 - Antagonized by naloxone
 - Tolerance develops with 7-OH-MG (mice)
 - Cross-tolerance to Morphine
 - Respiratory depression vs. Codeine



Kratom



- Administration
 - Chewing leaves
 - Tea
 - Powder/Capsules



- Side effects
 - Numb tongue
 - Nausea
 - Abdominal pain - "...I was forced to spend the rest of the day lying in severe pain" – Erowid user



Kratom Case



- Reckless driver called in by civilian
 - Driving into oncoming traffic
 - Believed he had a passenger side flat
 - Just learning stick shift
- Poor balance when exiting vehicle
- Officer observed sleeve rolled up



Kratom Case



- Observations
 - Constricted pupils
 - Droopy eyelids
 - Slow, lethargic movements
 - Disoriented
- Admitted to taking Kratom the evening prior
 - Otherwise, just took Rx for clonazepam
 - Later stated he also has Rx for gabapentin

Kratom Case



Kratom Case

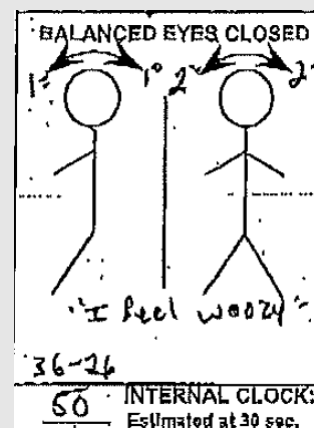


- Search of vehicle
 - Multiple prescription bottles
 - Bottom of aluminum can
 - Full syringe
 - Foil with 0.5 g heroin

DRE Eval



- Romberg balance
 - 30 seconds within 50 seconds
 - Swayed
- Walk and turn
 - Terrible balance
 - Tremors



DRE Eval



- One leg stand
 - Sway
 - Poor balance
- Finger to nose
 - Touched tip of nose 3/6 times
 - Used pad
 - "Lil bit of a challenge!"

ONE LEG STAND: 16/30

7 Sway to left 11-12

9

14 Fall

STOP Hold FOOT 2 more seconds

L R

Leg Transfers

<input checked="" type="checkbox"/>	Sways while balancing	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Uses arms to balance	<input checked="" type="checkbox"/>
<input type="checkbox"/>	Hopping	<input type="checkbox"/>
<input type="checkbox"/>	Puts foot down	<input checked="" type="checkbox"/>

DRE Eval



- HGN – none
- Lack of convergence – present
 - Left eye didn't move
- Pupils (little reaction to light)
 - Room light: 2.5 mm
 - Near total darkness: 3.0 mm
 - Direct light: 2.0 mm



DRE Eval



- Pulse – 68, 87, 82 BPM
(60 – 90)
- Blood pressure – 119/62
(120 – 140 / 70 – 90)
- Body temp: 97.3 (98.6 +/- 1)
- Muscle tone – near normal



DRE Eval



- Difficult blood draw
 - “IV drug user for 10 years”
- DRE called Narcotic Analgesics



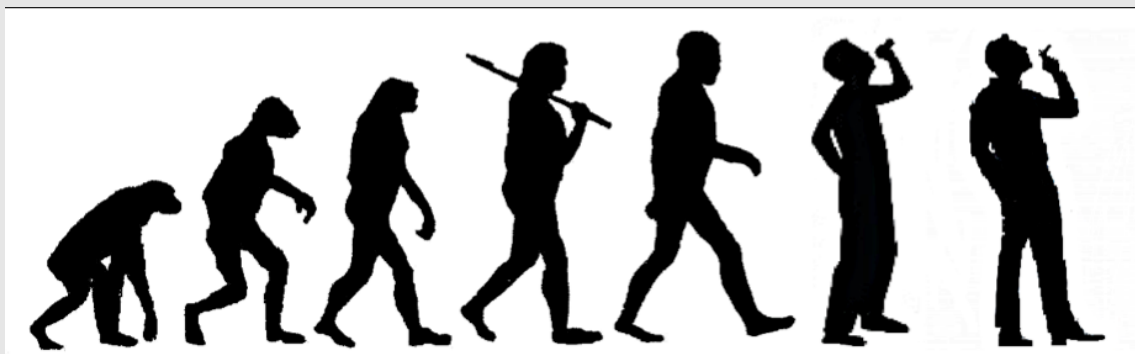
Kratom Case



- Codeine = 14 ng/mL
- Morphine = 160 ng/mL
- **Mitragynine = present**



NPS Challenges – Always Evolving



Partnerships and communication are key



Amy Miles
amy.miles@slh.wisc.edu



Wisconsin State
Laboratory of Hygiene
UNIVERSITY OF WISCONSIN-MADISON

WISCONSIN STATE LABORATORY OF HYGIENE -
UNIVERSITY OF WISCONSIN