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NPS DISCOVERY

Using LC-QTOF-MS for Sample-Mining and Data-Mining to Track NPS Emergence and Trends

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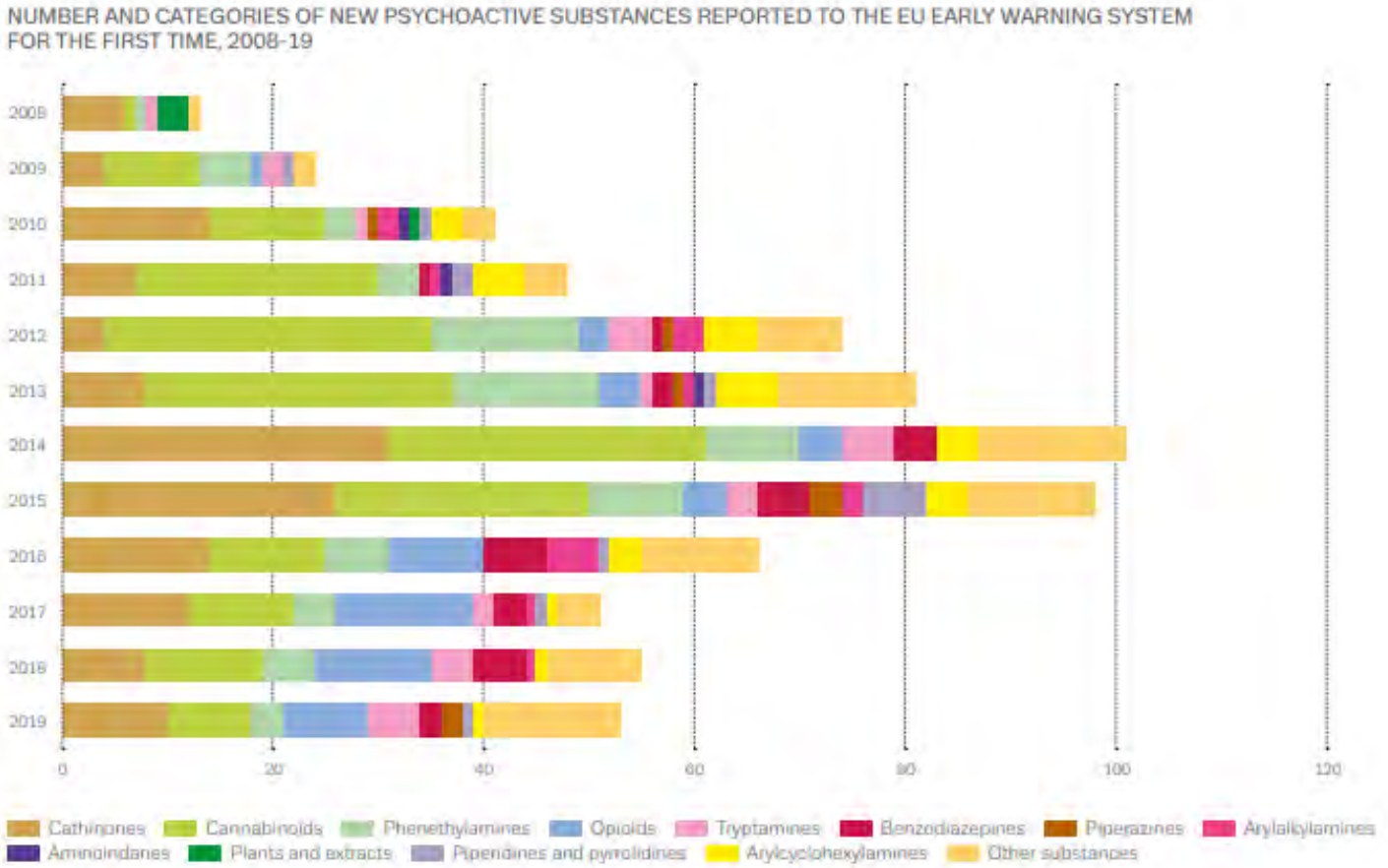
Research Scientist – CFSRE & Program Manager – NPS Discovery

Wednesday September 30, 2020 – 2020 CFS Toxicology Virtual Symposium

Background on NPS

Synthetic Drug Trends – Europe



Source: www.emcdda.europe.eu

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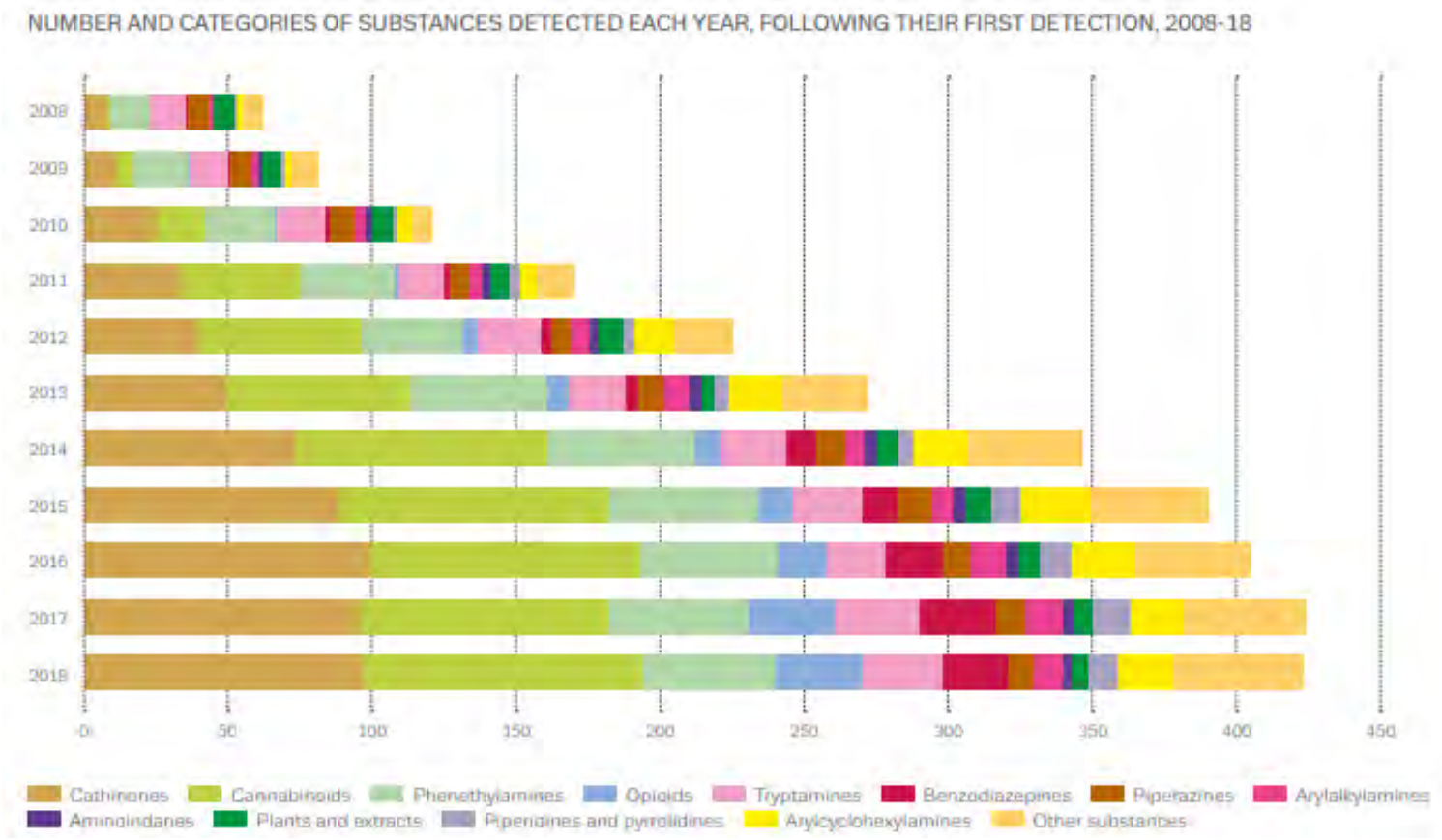
Synthetic Drug Trends – Europe



Source: www.emcdda.europe.eu

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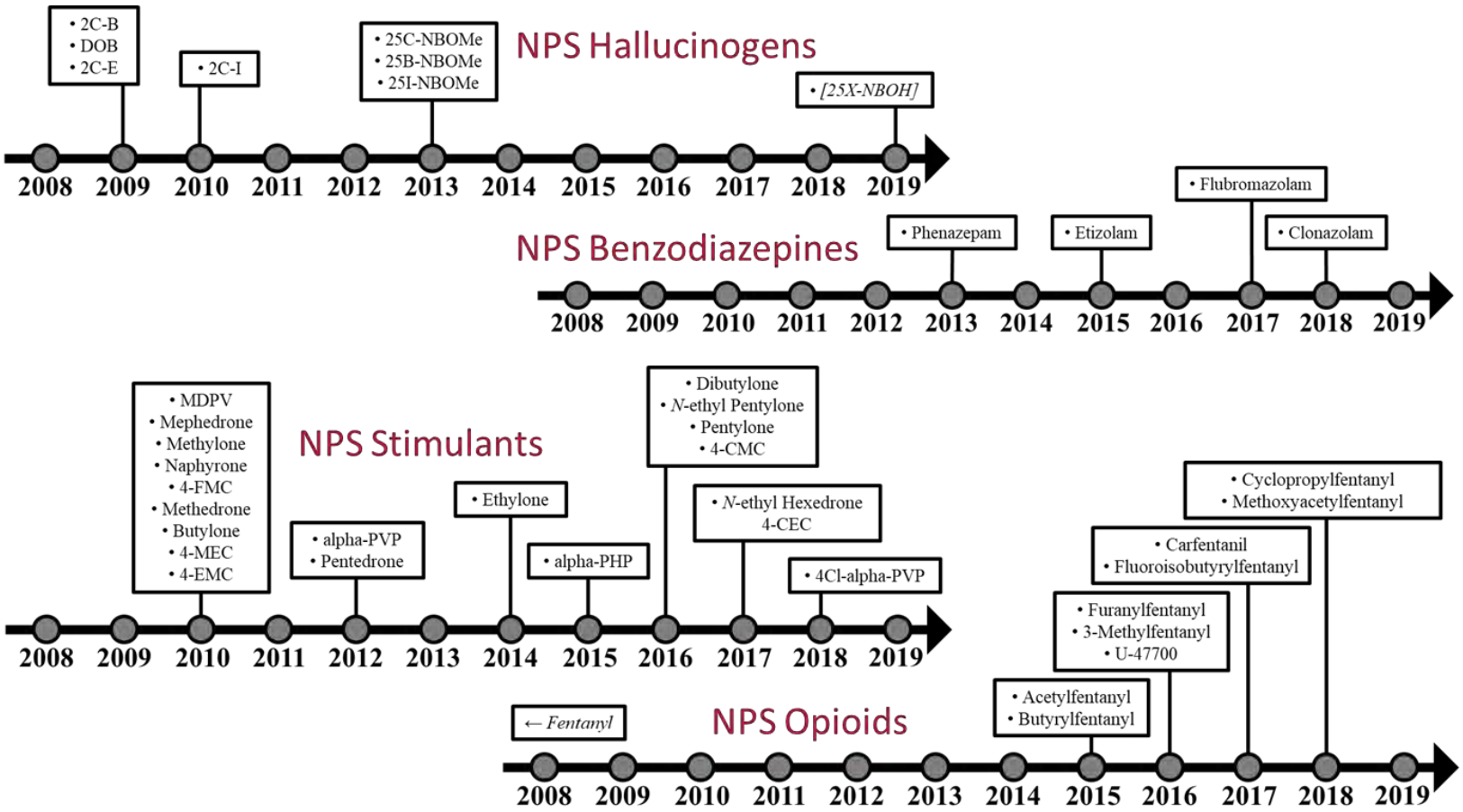
Synthetic Drug Trends – United States



Data: US Drug Enforcement Administration

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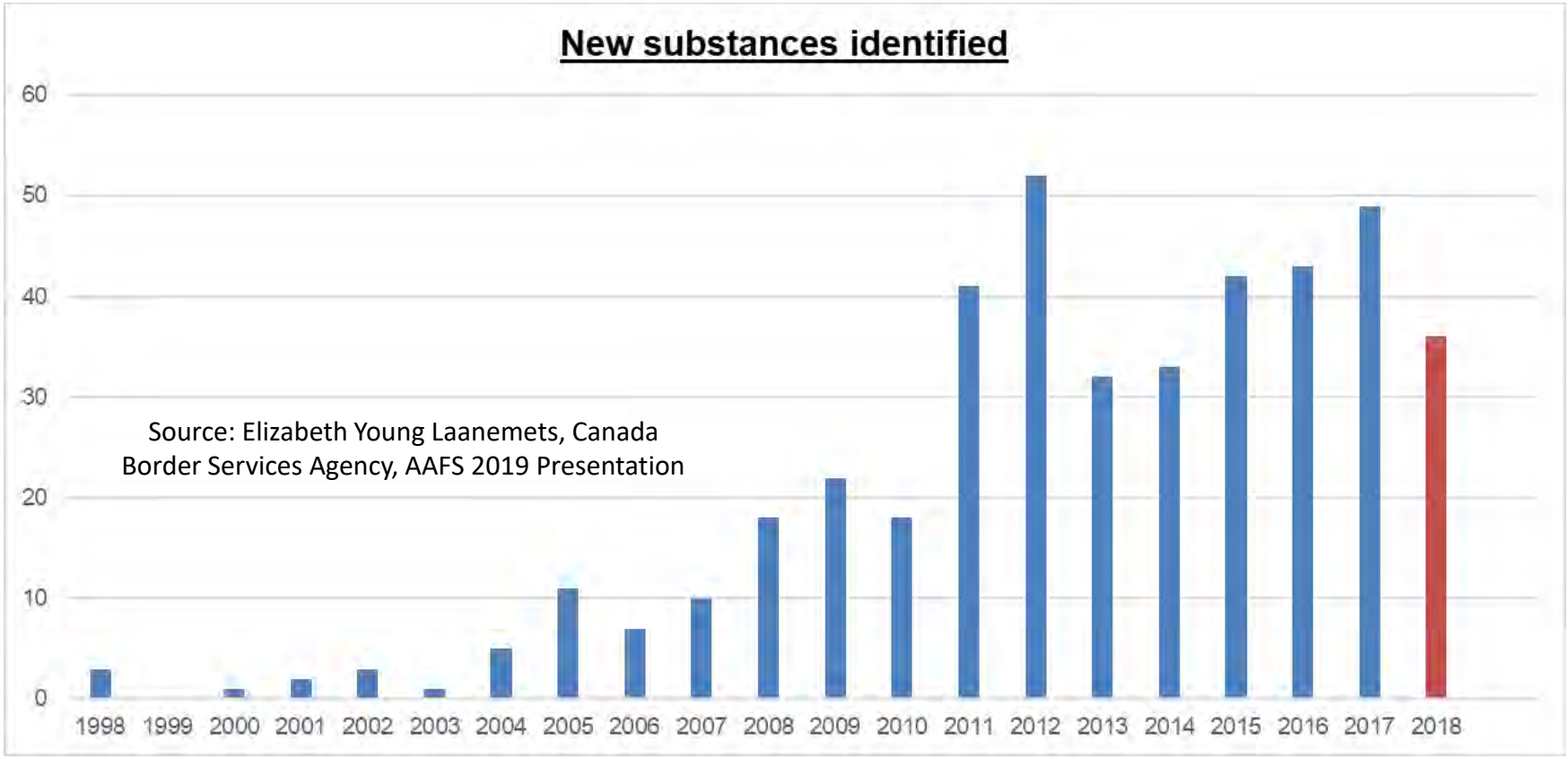
Synthetic Drug Trends – Canada



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Synthetic Drugs in the News

Morning Mix

‘It is taking people out’: More than 70 people overdose on K2 in a single day in New Haven

Over 200 Philly Heroin Users Poisoned Over the Weekend, Potentially Due to “K2”

NATION-WORLD

Enough fentanyl to kill 2 million people seized in NY home, DEA says

Fentanyl is a synthetic opioid similar to morphine but is 50 to 100 times more potent.

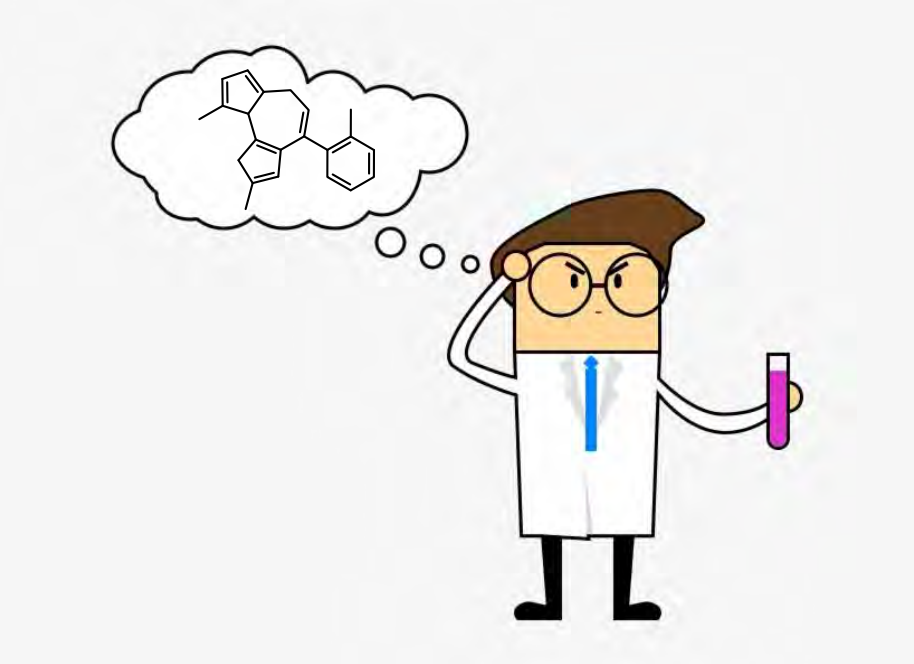
music music festivals

Seven dead: Mass deaths at music festivals from suspected drug overdoses

SEVEN young people have died from suspected drug overdoses in wha
music festival anywhere in the world.

Challenges

- Synthetic drugs present in forensically relevant samples often remain **unidentified** due to scope of analysis and analyst experience/expertise



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Challenges

- Synthetic drugs present in forensically relevant samples often remain **unidentified** due to scope of analysis and analyst experience/expertise

- First identification are often **lagging or delayed**
  - Analytical capabilities, testing performed
  - Standard reference material
  - Relation to previously identified NPS

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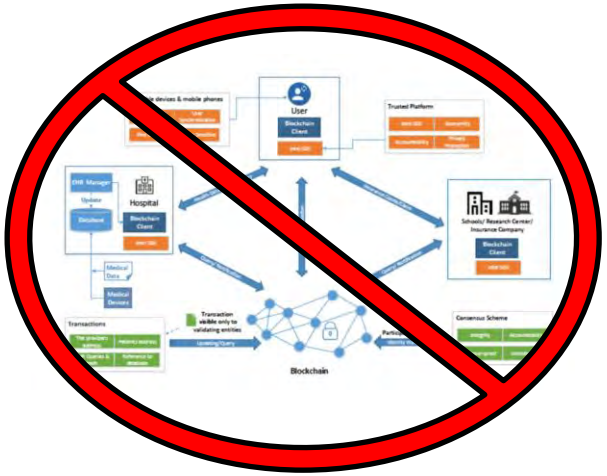
Challenges

- Synthetic drugs present in forensically relevant samples often remain **unidentified** due to scope of analysis and analyst experience/expertise

- First identification are often **lagging or delayed**
  - Analytical capabilities, testing performed
  - Standard reference material
  - Relation to previously identified NPS

- There is **no centralized reporting system** within the United States



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NPS Discovery

Our NPS Discovery Program

Forensic Toxicology Investigations

Clinical Intoxications

Seized Drug Analysis

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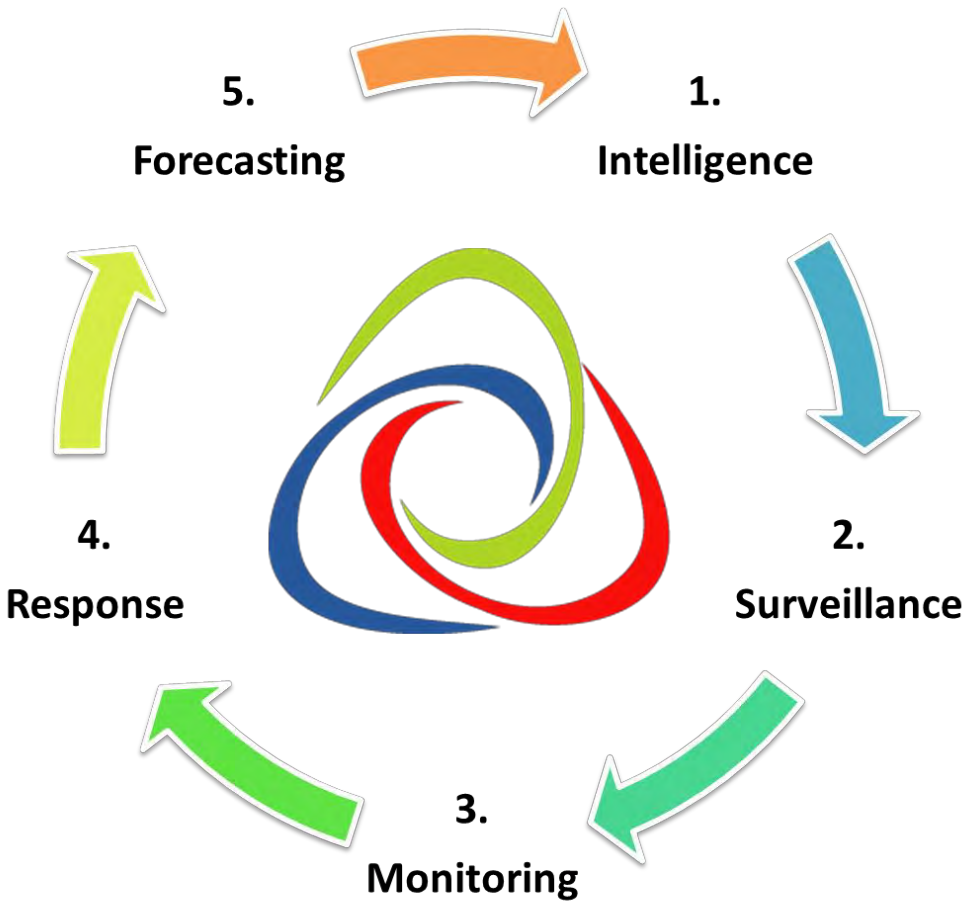

1. **Intelligence**
   - What is out there?
2. **Surveillance**
   - Have we seen it?
3. **Monitoring**
   - How often?
4. **Response**
   - What do we do?
5. **Forecasting**
   - What's next?

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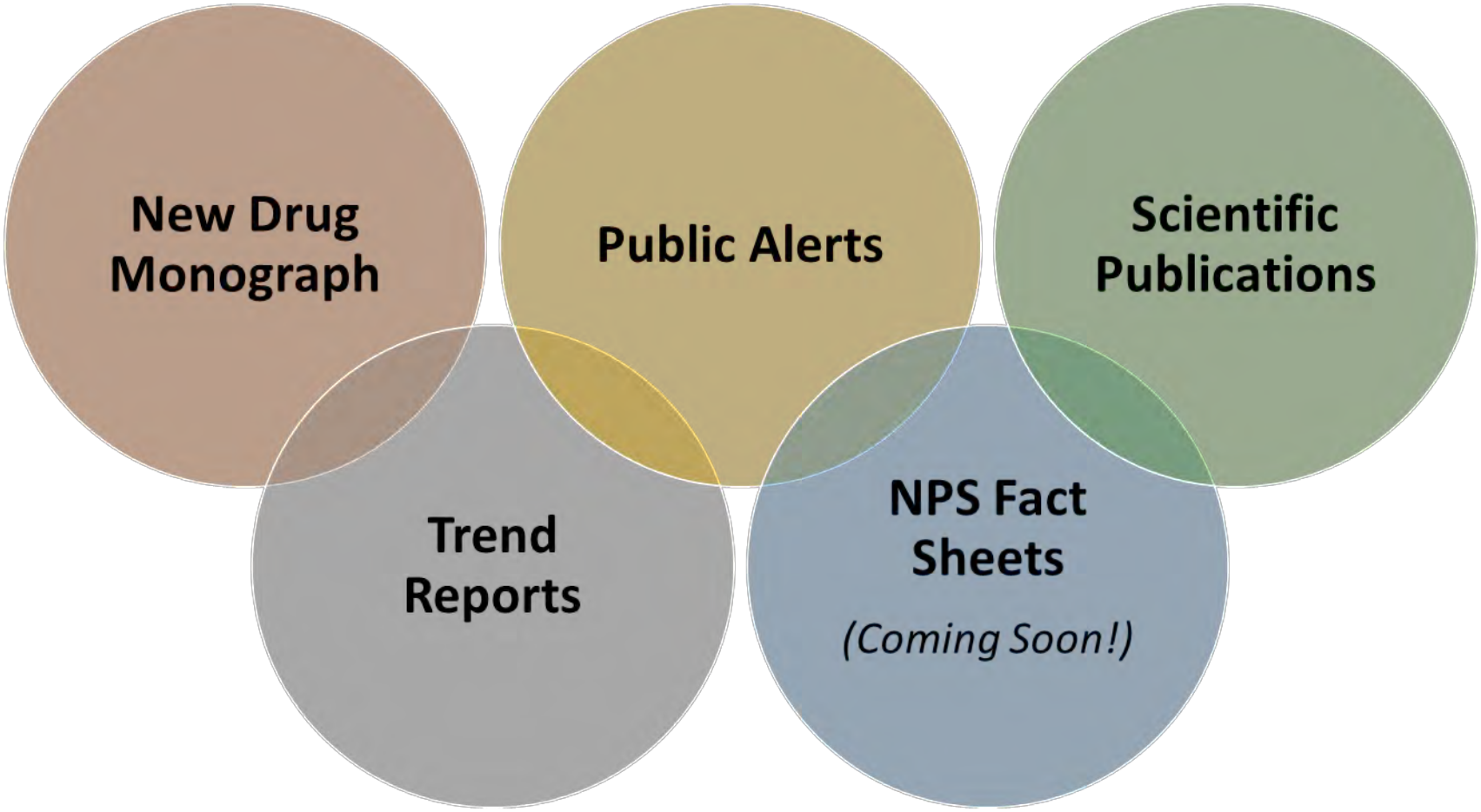

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Methods and Workflows

Seized Drug Workflow

- **Interdiction and collection of sample (typically white powder)**
- **GC-MS testing – determination of suspected NPS**
- **LC-QTOF-MS testing – tentative identification**
- **NMR testing – confirmation of structure**
- Report of results to scientific community – new drug monographs
- Monitoring future results (toxicology, clinical, seized drug, etc.)
- Notification of drug to public health – public alert
- Additional research – quantitation, metabolism, etc.

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GC-MS Testing

- **Sample Preparation:**
  - Acid/Base extraction
- **Instrument:**
  - Agilent 5975 Series GC/MSD →
- **Column & Carrier Gas:**
  - Zebron™ Inferno™ ZB-35HT (15 m x 250 µm x 0.25 µm)
  - Helium (Flow: 1 mL/min)
- **Temperature Program**
- **Injection Volume:** 1 µL
- **MS Parameters:** 40-550 m/z

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LC-QTOF-MS Testing

- **Sample Preparation:**
  - 1:100 dilution of GC-MS extract
- **Instrument:**
  - Sciex TripleTOF® 5600+ →
- **Column:**
  - Phenomenex® Kinetex C18 (50 mm x 3.0 mm, 2.6 µm)
- **Mobile Phase Gradient:**
  - A: Ammonium formate (10 mM, pH 3.0)
  - B: Methanol/acetonitrile (50:50)
- **Injection Volume:** 10 µL
- **MS Parameters:** 100-510 Da

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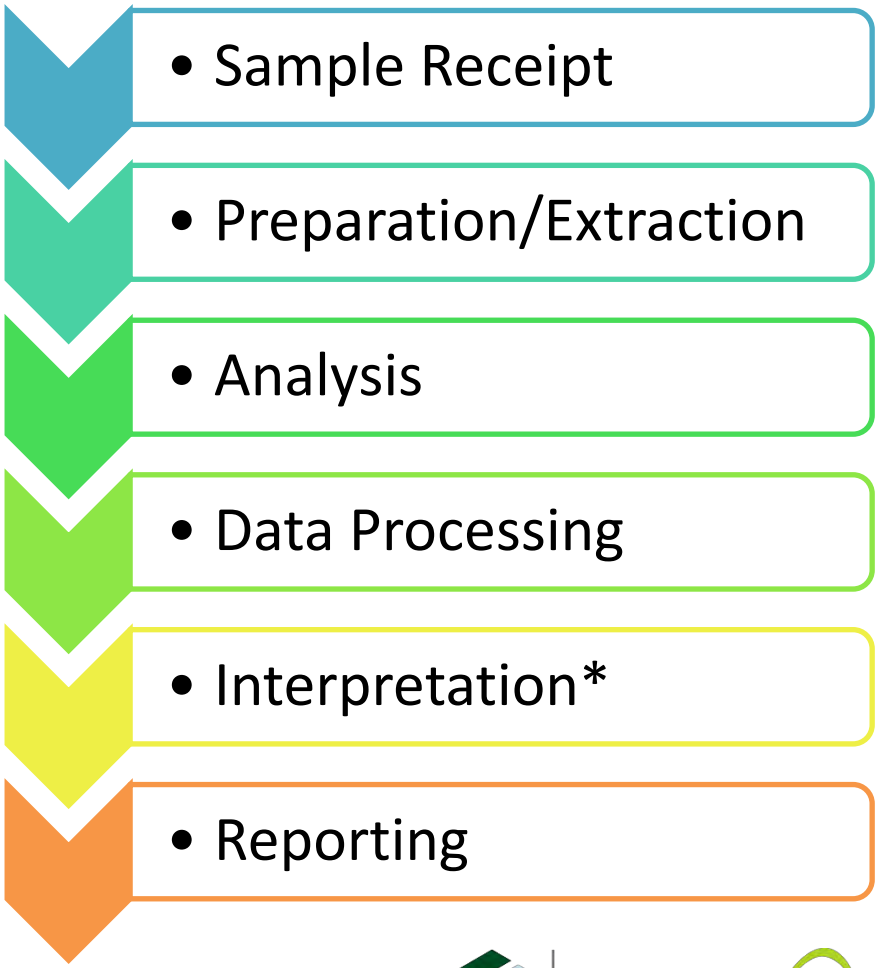
Toxicology Workflow



Sample Sources

- NMS Labs
- Medical Examiner
- Coroner
- Hospitals
- Poison Centers
- Other*

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Toxicology Workflow

- Sample Receipt
- Preparation/Extraction
- Analysis
- Data Processing
- Interpretation*
- Reporting

Discarded Extracts

NMS LABS

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LC-QTOF-MS Testing

- **Sample Preparation:**
  - Extraction via LLE or SPE
- **Instrument:**
  - Sciex TripleTOF® 5600+ →
- **Column:**
  - Phenomenex® Kinetex C18 (50 mm x 3.0 mm, 2.6 µm)
- **Mobile Phase Gradient:**
  - A: Ammonium formate (10 mM, pH 3.0)
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- **Injection Volume:** 10 µL
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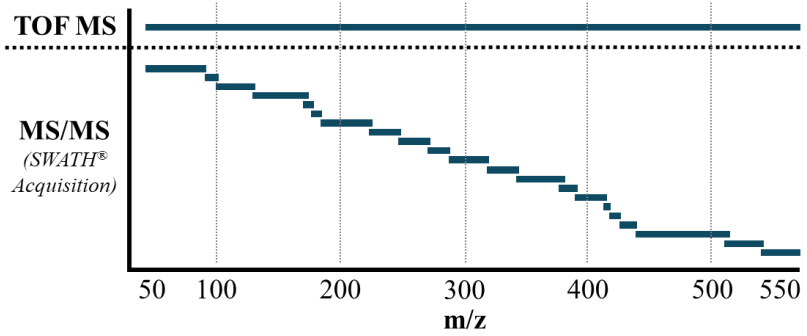
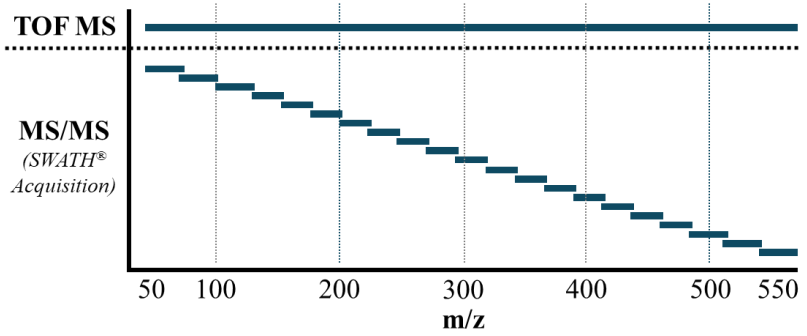
LC-QTOF-MS Methods

- Basic Drug Method
  - Generic LC gradient
  - SWATH® Acquisition



  - 15.5-minute method
  - **800+ drugs of abuse, NPS, metabolites, etc.**

- Synthetic Cannabinoid Method
  - Generic LC gradient
  - SWATH® Acquisition



  - 7-minute method
  - **250+ synthetic cannabinoids (parent and metabolites)**

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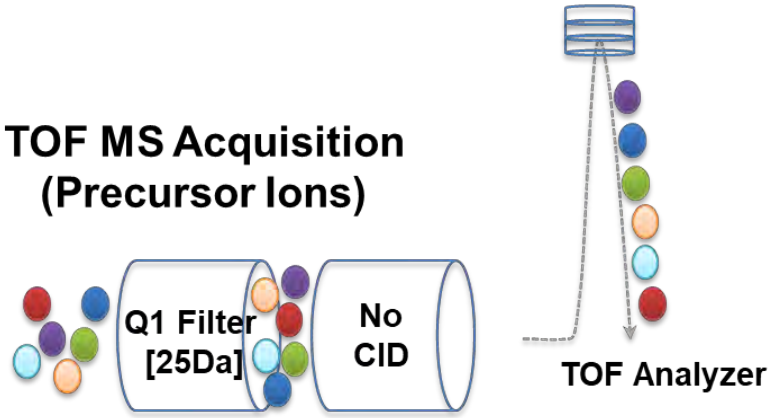
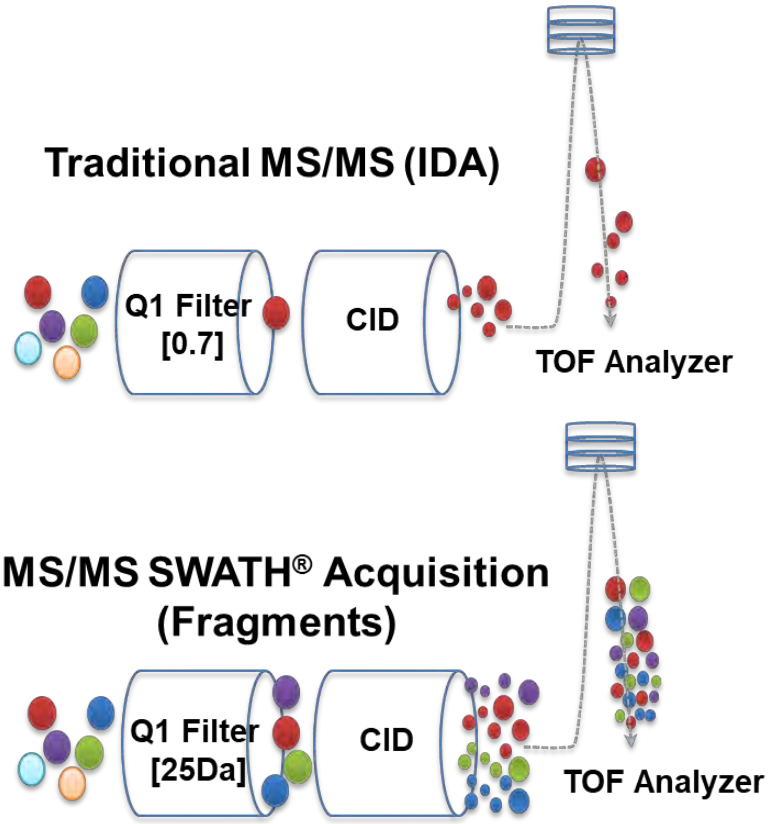
SWATH vs. IDA

- First Experiment



- Second Experiment



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Positive Identification Criteria

	Mass Error Mass Error (ppm)	Retention Time Delta (min)	Isotope Isotope Ratio % Difference	Library Hit Library Score
✓	< 5.0	< 0.25	< 30.0	> 90.0
▲	< 10.0	< 0.35	< 50.0	> 70.0
●	>= 10.0	>= 0.35	>= 50.0	<= 70.0

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LC-MS/MS Testing

- **Sample Preparation:**
  - Extraction via LLE or SPE
- **Instrument:**
  - Waters Xevo TQ-S micro →
- **Column:**
  - Agilent InfinityLab Poroshell 120 EC-C18 (3.0 mm x 100 mm, 2.7 µm)
- **Mobile Phase Gradient:**
  - A: Water with 0.1% formic acid
  - B: Methanol with 0.1% formic acid
- **Specialized MRM Parameters**
- **Standard Addition for Quantitation**

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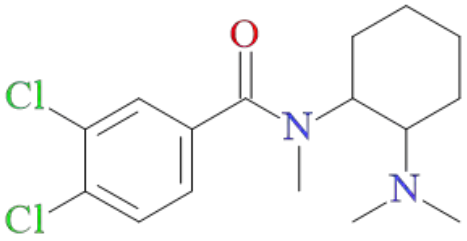
Sample-Mining vs. Data-Mining

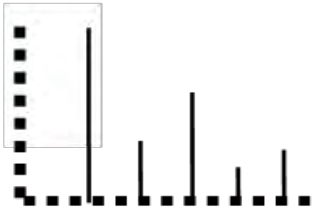
PAST:
Retrospective

Data Mining



When was U-47700 first detected but not identified?

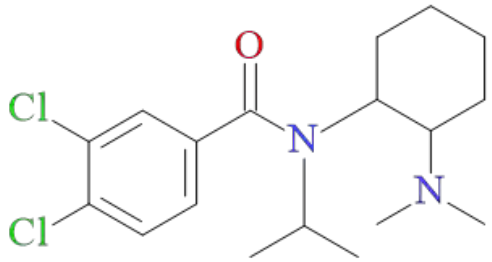
Sample Extracts



Analytical Data

PRESENT:
Real-Time

Sample Mining



When will isopropyl-U-47700 first be detected and identified?

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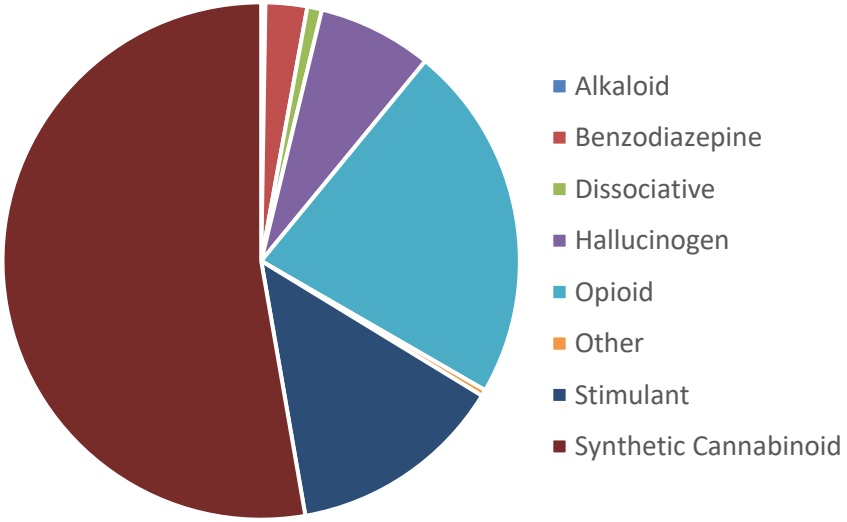
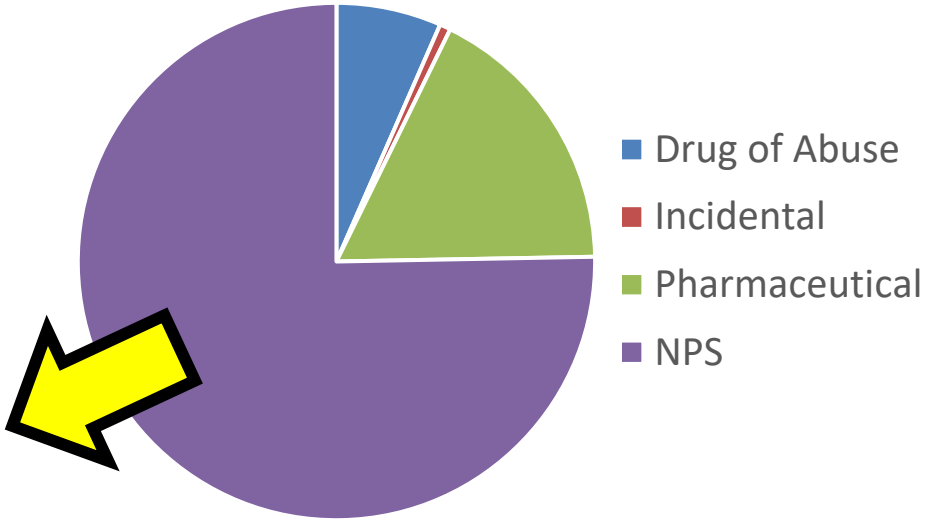
Standards / Library Database

- >875 standards in library database





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Results and Dissemination

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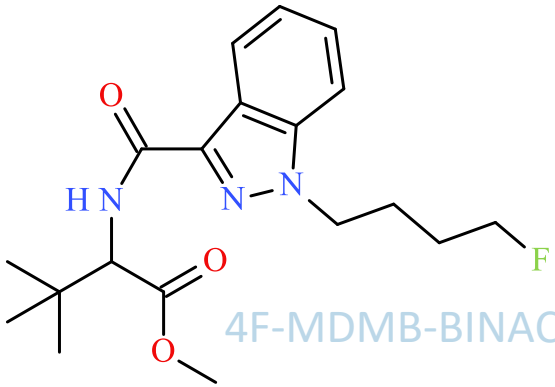
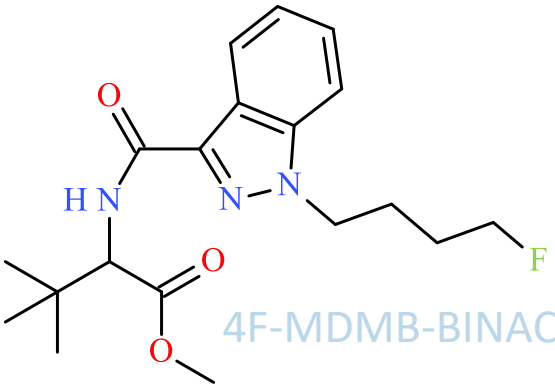
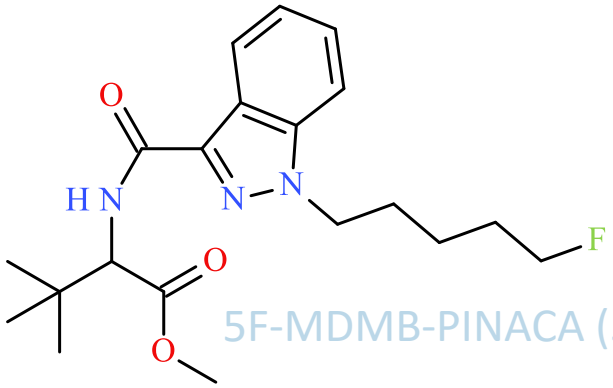
4F-MDMB-BINACA



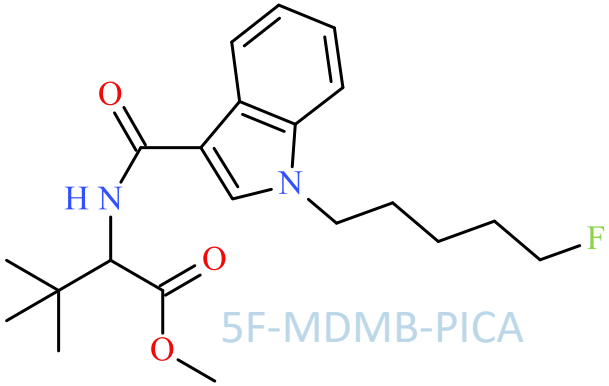
4F-MDMB-BINACA



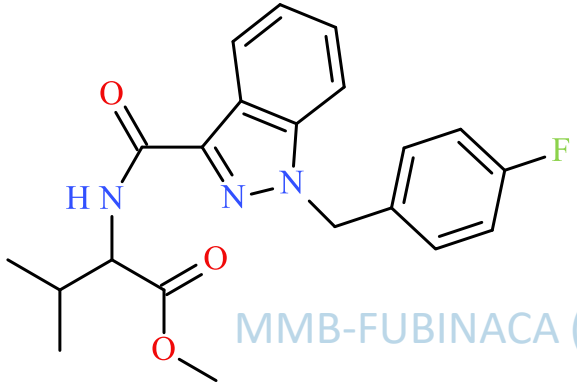
4F-MDMB-BINACA



5F-MDMB-PINACA (5F-ADB)



5F-MDMB-PICA



MMB-FUBINACA (FUB-AMB)

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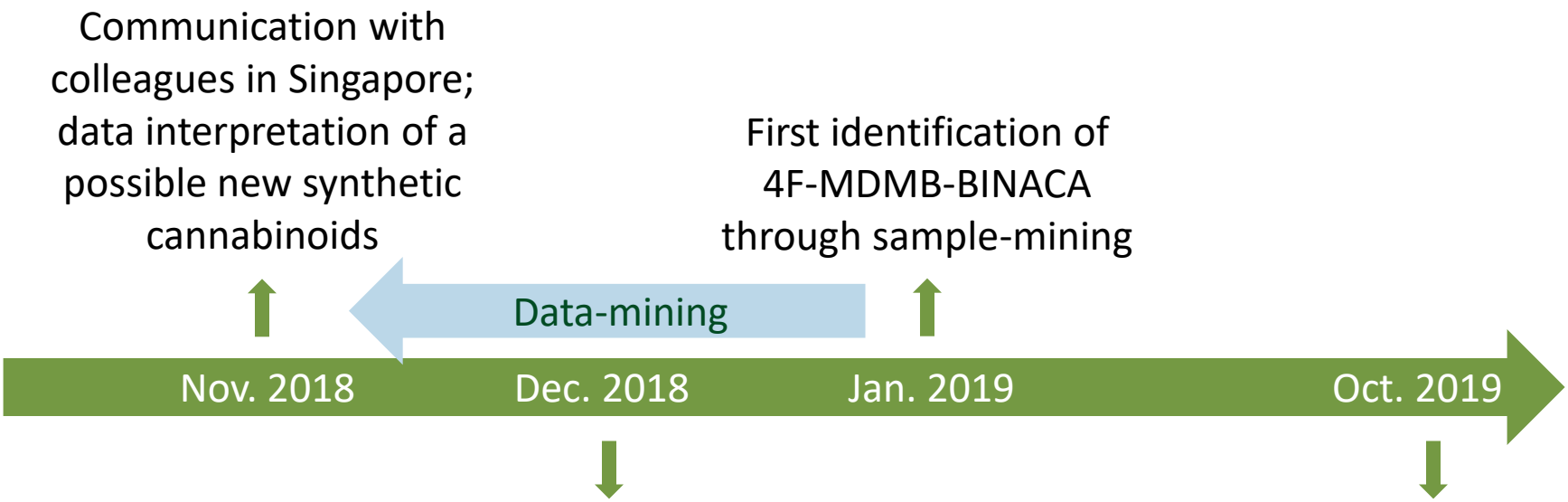
Timeline: 4F-MDMB-BINACA



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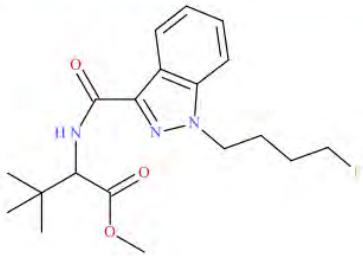
New Drug Monograph

NMS LABS

NMS Labs
2300 Stratford Ave
Willow Grove, PA 19090

4F-MDMB-BINACA



Sample Type: **Seized Material**

Latest Revision: **January 11, 2019**
Date Received: **December 21, 2018**
Date of Report: **January 11, 2019**

1. GENERAL INFORMATION

IUPAC Name:	Methyl 2-[[1-(4-fluorobutyl)indazole-3-carbonyl]amino]-3,3-dimethyl-butanoate
InChI String:	InChI=1S/C19H26FN3O3/c1-19(2,3)16(18(25)26-4)21-17(24)15-13-9-5-6-10-14(13)23(22-15)12-8-7-11-20/h5-6,9-10,16H,7-8,11-12H2,1-4H3,(H,21,24)
CFR:	Not Scheduled (01/2019)
CAS#	Not Available
Synonyms:	4F-MDMB-BUTINACA
Source:	Department of Homeland Security
Appearance:	Off-White Solid Material

2. CHEMICAL AND PHYSICAL DATA

2.1 CHEMICAL DATA

Form	Chemical Formula	Molecular Weight	Molecular Ion [M⁺]	Exact Mass [M+H]⁺
Base	$C_{19}H_{26}FN_3O_3$	363.4	363	364.2031

3. BRIEF DESCRIPTION

4F-MDMB-BINACA is classified as a synthetic cannabinoid. Synthetic cannabinoids have been reported to cause psychoactive effects similar to delta-9-tetrahyrocannabinol (THC). Synthetic cannabinoids have caused adverse events, including deaths, as described in the literature. 5F-MDMB-PINACA (5F-ADB) is a structurally similar compound and Schedule I substance in the United States.

4. ADDITIONAL RESOURCES

https://www.policija.si/apps/nfl_response_web/0_Analytical_Reports_final/4F-MDMB-BINACA-ID-HIFS-010.pdf

5. QUALITATIVE DATA

5.1 GAS CHROMATOGRAPHY MASS SPECTROMETRY (GC-MS)

Testing Performed At:	NMS Labs (Willow Grove, PA)
Sample Preparation:	Acid/Base extraction
Instrument:	Agilent 5975 Series GC/MSD System
Column:	Zebron™ Inferno™ ZB-35HT (15 m x 250 µm x 0.25 µm)
Carrier Gas:	Helium (Flow: 1 mL/min)
Temperatures:	Injection Port: 265 °C
	Transfer Line: 300 °C

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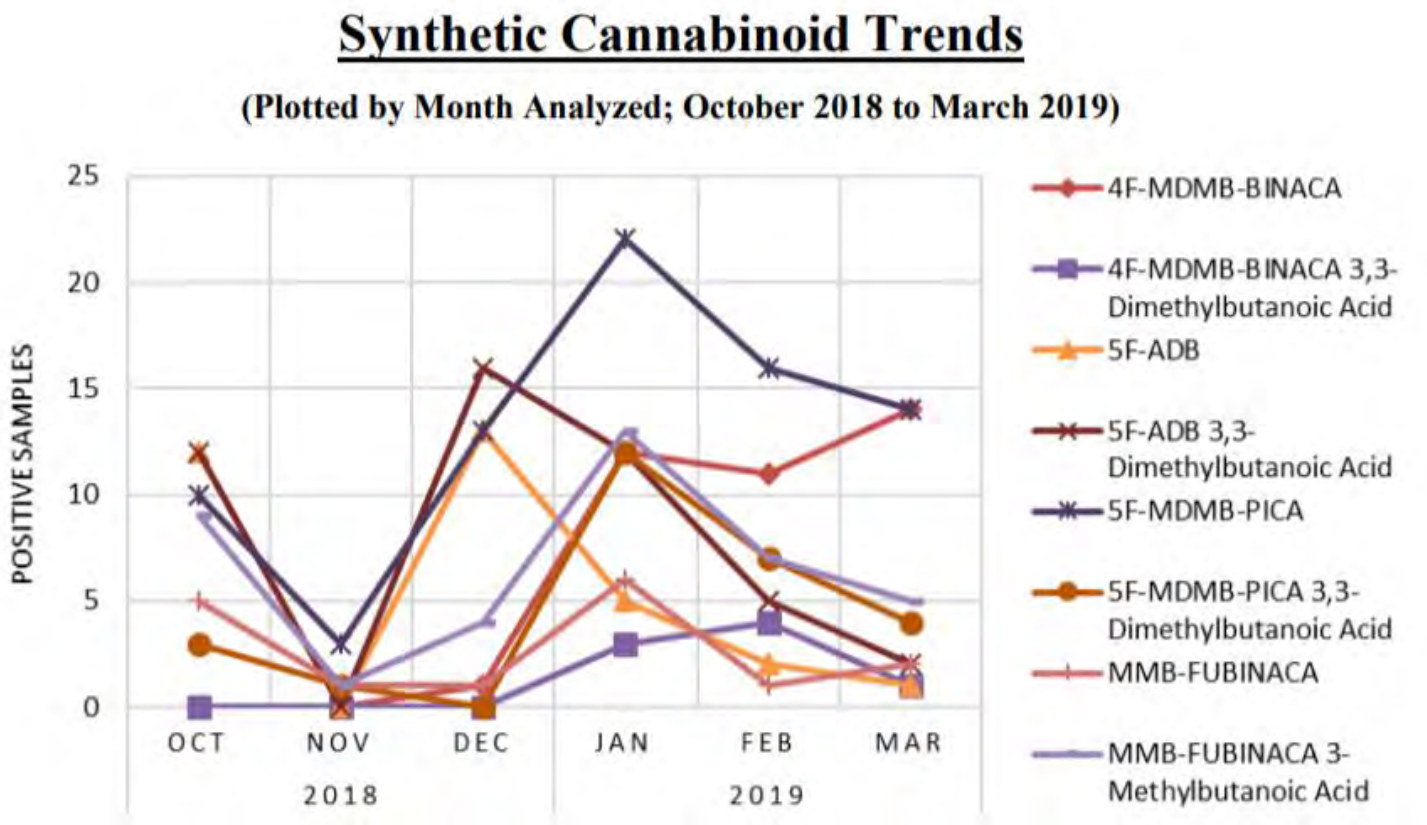
Toxicology Trends



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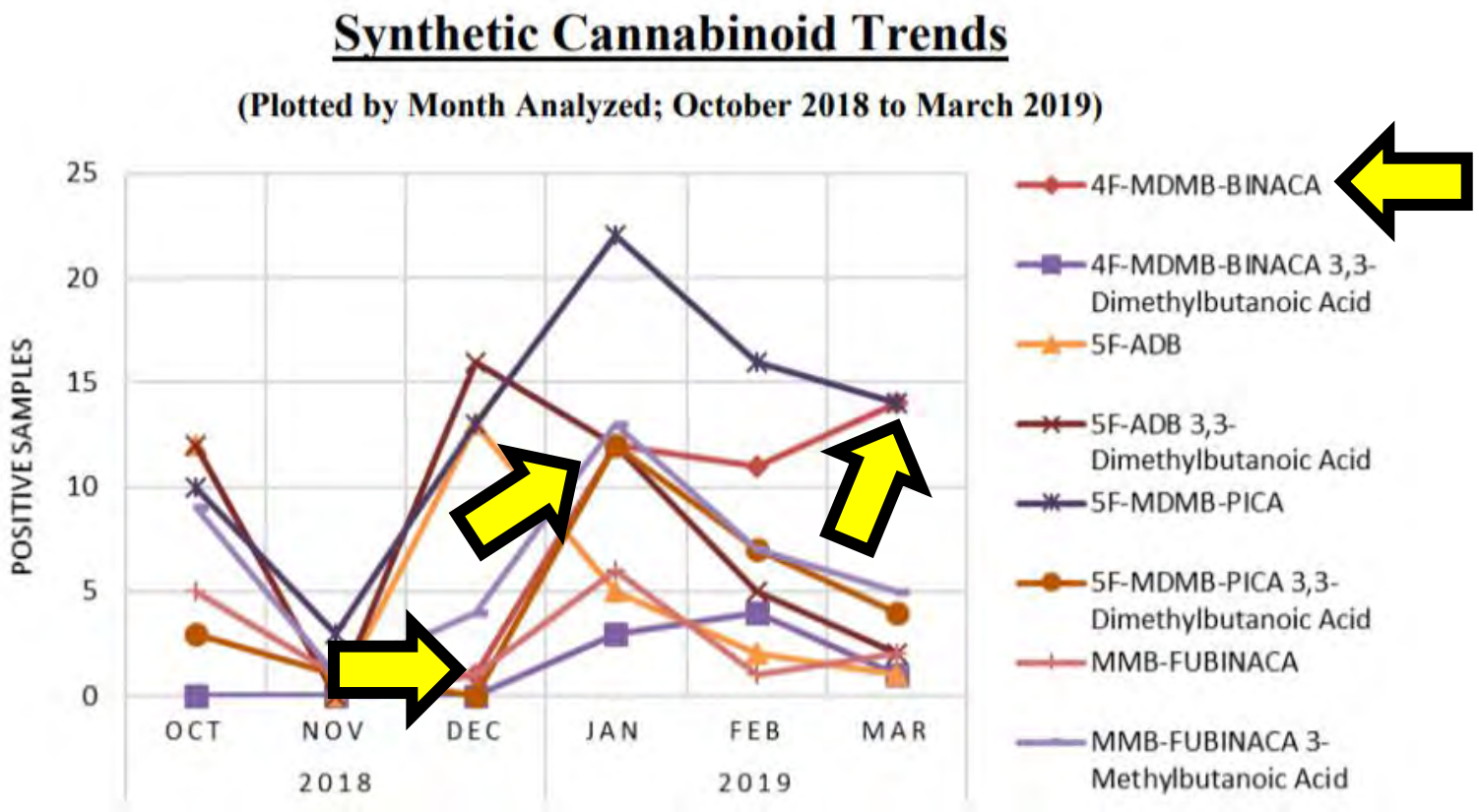
Toxicology Trends



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Public Alert

January 2019

New Synthetic Cannabinoid: 4F-MDMB-BINACA

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Purpose: The objective of this public announcement is to notify public health and public safety, law enforcement, clinicians, medical examiners and coroner, laboratory personnel, and all other related communities about new information surrounding the emergent synthetic cannabinoid 4F-MDMB-BINACA.

Summary: 4F-MDMB-BINACA, first identified in seized drug casework in the United States in December of 2018, has been identified in eight blood specimens associated with post-mortem death investigations and driving under the influence of drugs (DUID) investigations. 4F-MDMB-BINACA is very similar in structure to the popular synthetic cannabinoid 5F-ADB (5F-MDMB-PINACA), differing by the removal of one carbon (-CH_2-) linkage from the carbon chain (or tail) portion of the molecule. 5F-ADB has been associated with a large number of adverse events, including death. The pharmacology and toxicity of 4F-MDMB-BINACA have not been explicitly studied; but its relation to 5F-ADB and association with drug user deaths lead professionals to believe this new synthetic cannabinoid would be an active novel psychoactive substance (NPS) and retain the potential to cause adverse events.

Background: Synthetic cannabinoids ("Spice" or "K2") are chemically manufactured drugs, often associated with unknown biological effects and health risks, a dangerous combination for any recreational drug user. Synthetic cannabinoids can be prepared (e.g. plant material, powder) and packaged (e.g. foil packaging) in a variety of forms. Recently, synthetic cannabinoids have been identified in combination with more traditional drug supplies, including the heroin supply in Philadelphia, PA; a circumstance that lead to more the 160 drug overdoses in the city over one weekend from the drug combination 5F-ADB, fentanyl, and heroin. Adverse effects reported in association with synthetic cannabinoid use include neurological abnormalities (e.g., psychosis, agitation, irritability, paranoia, confusion, anxiety, etc.), psychiatric episodes (e.g., hallucinations, delusions, self-harm, etc.), other physical ailments (e.g., tachycardia, hypertension, arrhythmia, chest pain, tachypnea, gastrointestinal distress, acute kidney injury, nausea, vomiting, fever, hyperglycemia, hypokalemia, etc.), and death.

Demographics

Age:
- Adolescent to Adult

Sex:
- Male (n=5), Female (n=1)

Case Type:
- Death (n=5), DUID (n=3)

Specimen Type:
- Blood (n=8)

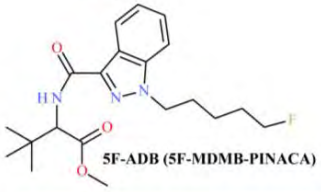
Date of Collection:
- Dec. 2018, Jan. 2019

Other Notable Findings:
- 5F-MDMB-PICA (n=4)
- 5F-ADB (n=2)
- No Other Findings (n=3)

Recommendations for Public Health

- Explore methods for rapidly identifying drug overdose outbreaks.
- Engage local poison centers and clinicians to assist with treatment of patients.
- Track and monitor geographical drug trends.
- Track demographics and known risk factors for decedents and overdose patients.
- Raise awareness about the risks and dangers associated with synthetic cannabinoids.
- Develop public health messaging about synthetic cannabinoids.

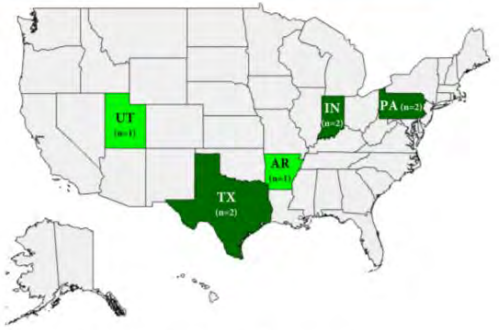
4F-MDMB-BINACA



5F-ADB (5F-MDMB-PINACA)

Recommendations for Clinicians

- Become familiar with the signs and symptoms associated with synthetic cannabinoid use; can range from profound agitated delirium to sedation, difficulty in arousal, and bradycardia. Symptoms can alternate and overlap.
- Be aware that clinical conditions may change rapidly and unpredictably.
- Be mindful that illicit drugs have limited quality control, containing undeclared substances that impact the expected clinical effects or findings.
- Counsel about the dangers of synthetic cannabinoid products and other drugs.



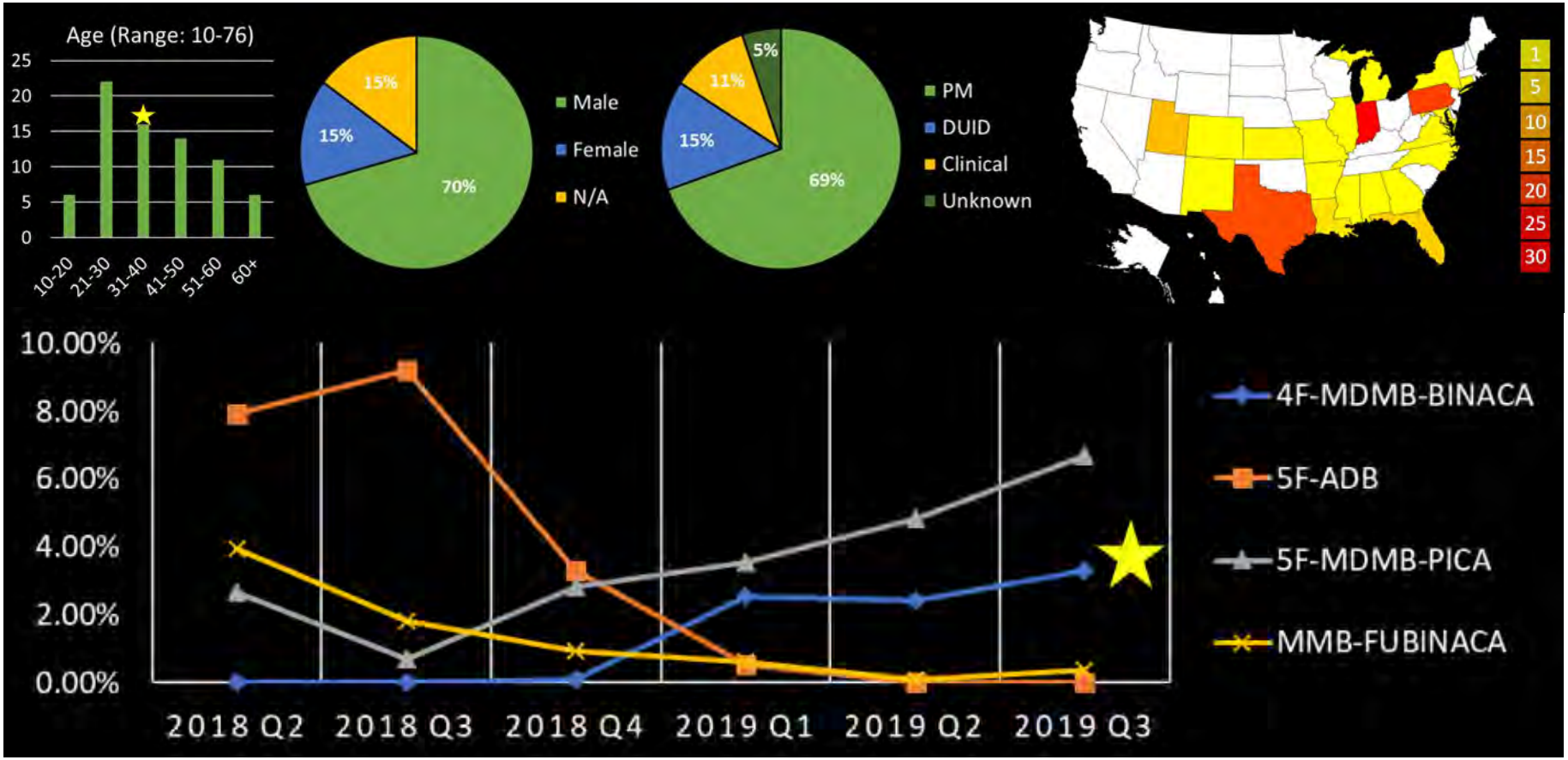
Recommendations for ME's & Coroners

- Test for new synthetic cannabinoids and their biomarkers in suspected synthetic cannabinoid overdose cases.
- Consider testing for synthetic cannabinoids if circumstances result in an unspecified drug fatality.
- Be aware that ELISA screening for synthetic cannabinoids may not be specific or specialized for the newest generation of compounds; consider mass spectrometry-based screening.
- Be aware that concentrations of synthetic cannabinoids in biological specimens can be very small in comparison to other drugs or NPS; GC-MS sensitivity may not adequate.

Recommendations for Laboratories

- Utilize analytical data available publicly for the identification of 4F-MDMB-BINACA and other synthetic cannabinoids if reference standards are not available to your laboratory.
- Develop sensitive and up-to-date testing procedures for synthetic cannabinoids.
- Prioritize analytical testing of seized drug samples taken from drug overdose scenes during death investigations.
- Share data on synthetic cannabinoid drug seizures with local health departments, medical examiners, and coroners.

Further Monitoring



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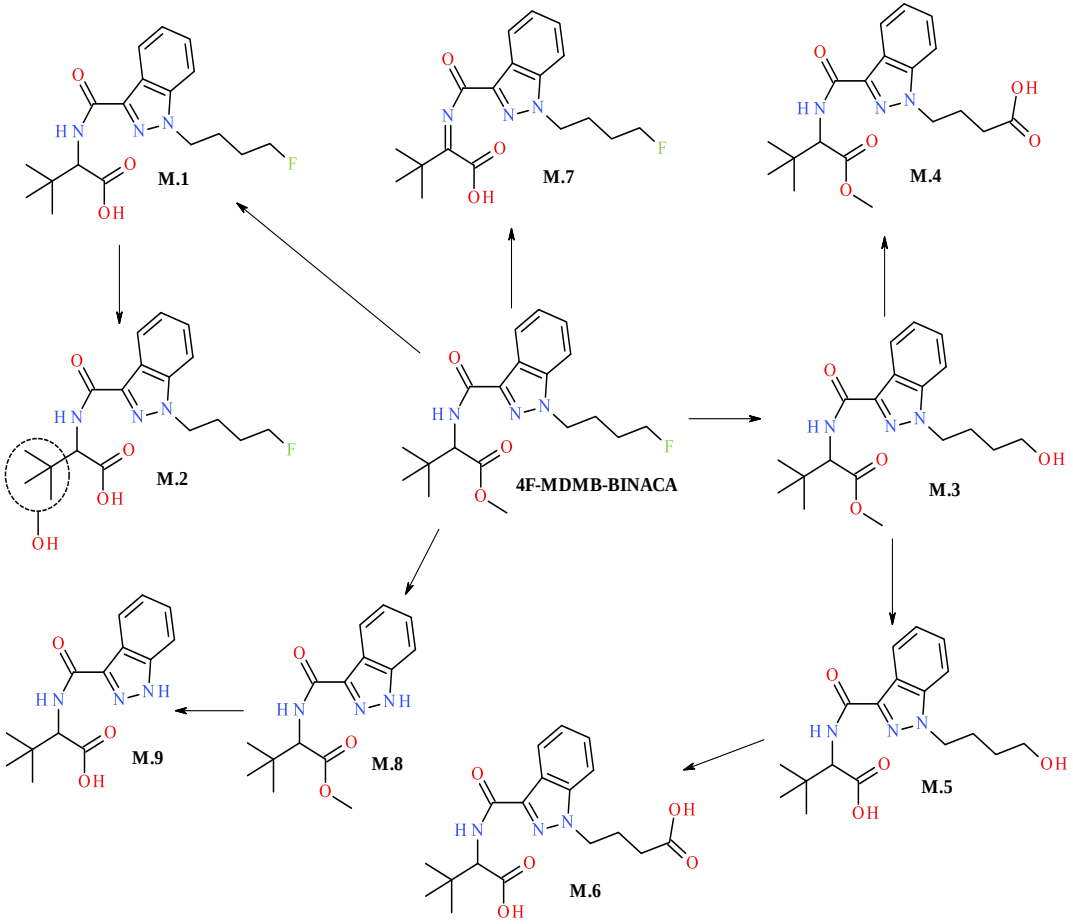
Further Monitoring



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JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, 2019
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PAPER

TOXICOLOGY

Alex J. Krotulski,[1] *M.S.F.S.; Amanda L.A. Mohr*,[1] *M.S.F.S.; Sherri L. Kacinko*,[2] *Ph.D.; Melissa F. Fogarty*,[1] *M.S.F.S.; Sarah A. Shuda*,[1] *M.S.F.S.; Francis X. Diamond*,[1] *B.S.; William A. Kinney*,[3] *Ph.D.; M.J. Menendez*,[4] *J.D.; and Barry K. Logan*,[1] *Ph.D.*

4F-MDMB-BINACA: A New Synthetic Cannabinoid Widely Implicated in Forensic Casework*,†

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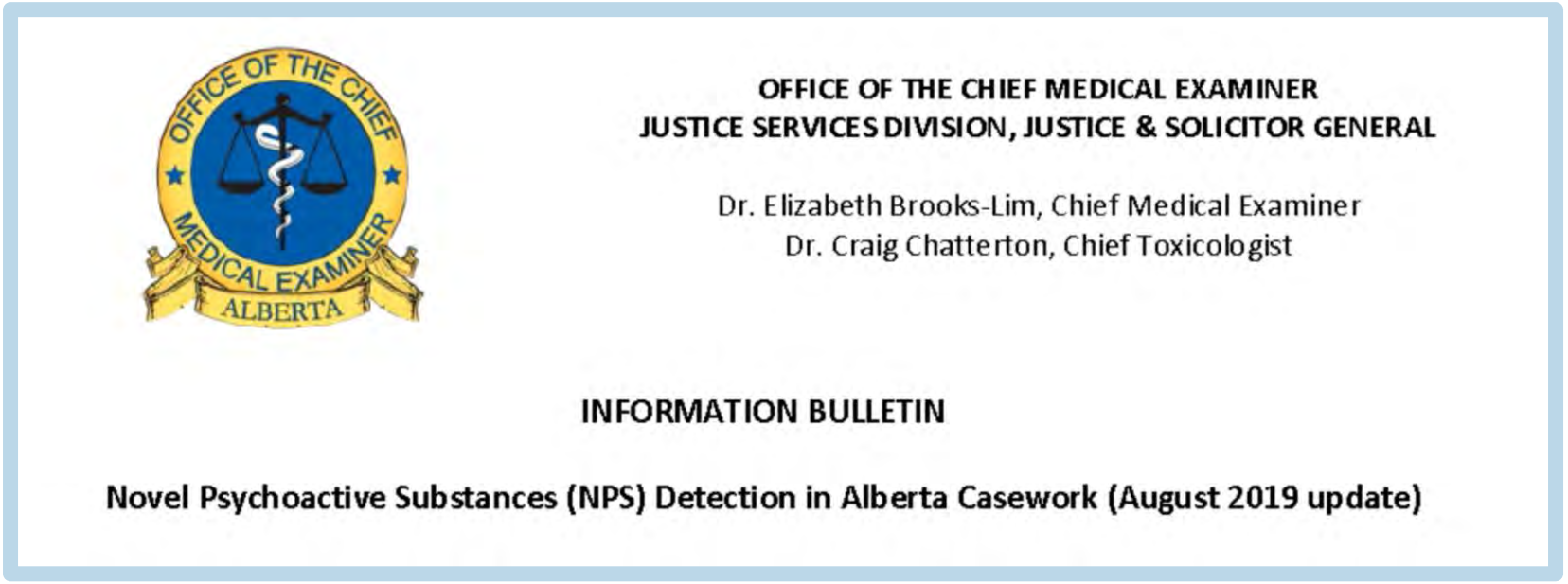
New Synthetic Opioids

- Aggressively update library database (n>875)

- Isotonitazene reported in Canada in August 2019



OFFICE OF THE CHIEF MEDICAL EXAMINER
JUSTICE SERVICES DIVISION, JUSTICE & SOLICITOR GENERAL

Dr. Elizabeth Brooks-Lim, Chief Medical Examiner
Dr. Craig Chatterton, Chief Toxicologist

INFORMATION BULLETIN

Novel Psychoactive Substances (NPS) Detection in Alberta Casework (August 2019 update)

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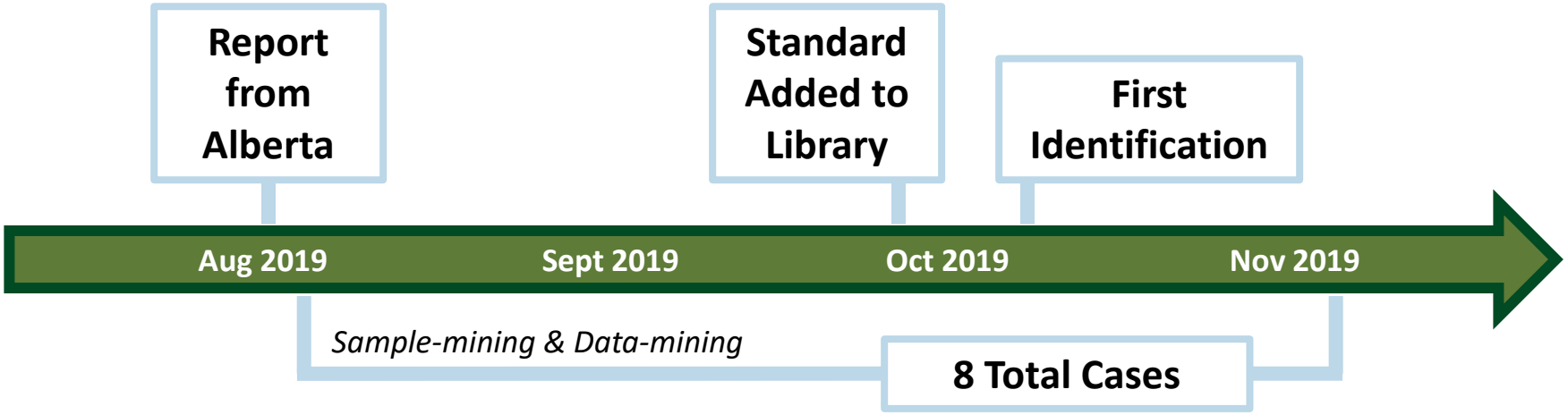
New Synthetic Opioids

- Aggressively update library database (n>800)

- Isotonitazene reported in Canada in August 2019



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New Drug Monograph

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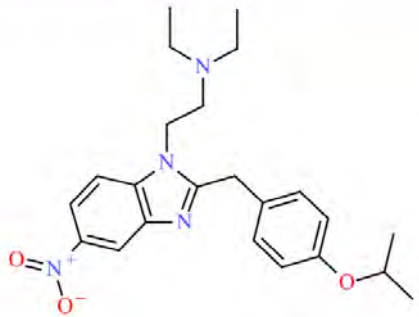
TEMPLE UNIVERSITY

Isotonitazene

Sample Type: **Biological Fluid**



Latest Revision: **November 21, 2019**

Date of Report: **November 19, 2019**

1. GENERAL INFORMATION

IUPAC Name:	N,N-diethyl-2-[2-[(4-isopropoxyphenyl)methyl]-5-nitro-benzimidazol-1-yl]ethanamine
InChI String:	InChI=1S/C23H30N4O3/c1-5-25(6-2)13-14-26-22-12-9-19(27(28)29)16-21(22)24-23(26)15-18-7-10-20(11-8-18)30-17(3)4/h7-12,16-17H,5-6,13-15H2,1-4H3
CFR:	Not Scheduled (11/2019)
CAS#	14188-81-9
Synonyms:	None Available
Source:	NMS Labs – Toxicology Department

3. SAMPLE HISTORY

Isotonitazene has been identified in eight cases since August 2019. The geographical and demographical breakdown is below:

Geographical Location:	Illinois (n=4), Indiana (n=4)
Biological Sample:	Blood (n=8)
Date of First Receipt:	August 20, 2019
Other Notable Findings:	Etizolam (n=6), Fentanyl (n=3), U-47700 (n=1), Piperidylthiambutene (n=1)

4. BRIEF DESCRIPTION

Isotonitazene is classified as a novel opioid but is dissimilar from fentanyl and U-series analogues. Novel opioids have been reported to cause psychoactive effects similar to heroin, fentanyl, and other opioids. Novel opioids have also caused adverse events, including deaths, as described in the literature. Structurally similar compounds to isotonitazene include etonitazene, metonitazene, and clonitazene. These synthetic opioids were first synthesized and reported in the literature in the 1950s.[1] Data suggests that this group of analogues have potency similar to or greater than fentanyl.[2] Etonitazene is reported to be the most potent followed by isotonitazene and metonitazene. Isotonitazene is not explicitly a scheduled substance in the United States; however, etonitazene and clonitazene are Schedule I substances. Identifications of isotonitazene have been previously reported in Canada (Alberta) and Europe (Belgium) from both seized drug and toxicology casework.

5. ADDITIONAL RESOURCES

1. Hunger, A; Kebrle, J; Rossi, A; Hoffmann, K. (1957) Synthesis of analgesically active benzimidazole derivatives with basic substitutions. *Experientia*, **13**, 400-401. https://link-springer-com.proxyiub.uits.iu.edu/article/10.1007/BF02161116

2. Hoffmann, K; Hunger, A; Rossi, A. (3 May 1960). "Patent US2935514A – Benzimidazoles." https://patents.google.com/patent/US2935514A/en

https://www.caymanchem.com/product/27255

Public Alert

November 2019

Potent Synthetic Opioid - Isotonitazene - Recently Identified in the Midwestern United States

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Purpose: The objective of this public announcement is to notify public health and public safety, law enforcement, clinicians, medical examiners and coroners, laboratory personnel, and all other related communities about new information surrounding the emergent synthetic opioid isotonitazene.

Background: Synthetic opioids are chemically manufactured drugs, often associated with unknown biological effects and health risks, a dangerous combination for any recreational drug user. Synthetic opioids are often prepared in powder or tablet form and can be mixed with street level traditional opioids. In the United States, a staggering number of deaths have been reported in recent years linked to synthetic opioid use. The primary adverse effect most commonly reported in association with synthetic opioid use is respiratory depression, often leading to death.

Summary: Isotonitazene is a potent synthetic opioid bearing structural resemblance to etonitazene, a synthetic opioid that is nationally and internationally controlled. Isotonitazene is dissimilar in structure to popular synthetic opioids typically encountered in forensic casework (e.g. fentanyl analogues, U-series analogues). Isotonitazene and similar analogues (e.g. etonitazene, metonitazene, and clonitazene) were first synthesized and reported in the literature in the 1950s. Pharmacological data suggest that this group of synthetic opioids have potency similar to or greater than fentanyl based on their structural modifications. Etonitazene is reported to be the most potent of the group followed by isotonitazene and metonitazene. The toxicity of isotonitazene has not been extensively studied but recent association with drug user death leads professionals to believe this new synthetic opioid retains the potential to cause widespread harm and is of public health concern. Isotonitazene has been identified in eight blood specimens associated with postmortem death investigations in the United States since August 2019. Isotonitazene was first reported in August 2019 based on the results from seized drug and toxicology casework in Europe (Belgium) and Canada (Alberta); the Canadian toxicology case was collected in March 2019.

Demographics

Age:
- Avg. 42, Med. 42.5
- Range: 20's to 60's

Sex:
- Male (n=6), Female (n=2)

Case Type:
- Postmortem (n=8)

Specimen Type:
- Blood (n=8)

Date of Collection:
- Aug. to Oct. 2019

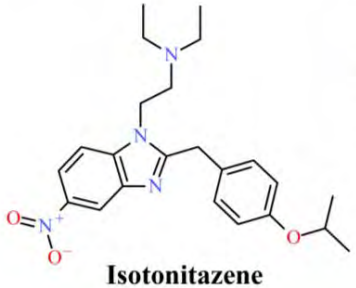
Other Notable Findings:
- Etizolam (n=6)
- Fentanyl (n=3)
- U-47700 (n=1)
- Piperidylthiambutene (n=1)

Recommendations for Public Health

- Implement surveillance for rapid identification of drug overdose outbreaks.
- Engage local poison centers and clinicians to assist with treatment of affected patients.
- Track and monitor geographical drug distribution and trends.
- Track demographics and known risk factors for decedents and overdose patients.
- Raise awareness about the risks and dangers associated with opioid use.
- Make naloxone available to recreational drug users.

Recommendations for Clinicians

- Become familiar with the signs and symptoms associated with synthetic opioid use (e.g. sedation, respiratory depression).
- Naloxone should be administered to reverse critical respiratory depression. Be aware that clinical conditions may change rapidly and unpredictably after naloxone administration due to precipitation of withdrawal.
- Be mindful that illicit drugs have limited quality control, containing undeclared substances that impact the expected clinical effects or findings.
- Counsel about the dangers of synthetic opioid products and other drugs.



Isotonitazene

Recommendations for MEs & Coroners

- Test for new synthetic opioids and their biomarkers in suspected opioid overdose cases.
- Be aware that ELISA screening for synthetic opioids may not be specific or specialized for the newest generation of compounds; consider mass spectrometry-based screening.
- Be aware that concentrations of synthetic opioids in biological specimens can vary and GC-MS sensitivity may not be adequate.

Recommendations for Laboratories

- Utilize analytical data available publicly for the identification of isotonitazene and other synthetic opioids if reference standards are not available.
- Utilize previously developed non-targeted testing protocols or develop sensitive and up-to-date testing procedures for synthetic opioids.
- Prioritize analytical testing of seized drug samples taken from drug overdose scenes during death investigations.
- Share data on synthetic opioid drug seizures with local health departments, medical examiners, and coroners.

Further Monitoring

- Quantitation by standard addition using LC-MS/MS

Reference Comment(s):

1. Isotonitazene is a potent synthetic opioid. To date, eighteen death investigation cases have been confirmed positive for isotonitazene, nine of which were previously negative for any opioid. The average isotonitazene concentration in blood was 2.2±2.1 ng/mL (median 1.75 ng/mL, range 0.4-9.5 ng/mL) and the average isotonitazene concentration in urine was 2.4±1.4 ng/mL (median 2.7 ng/mL, range 0.6-3.5 ng/mL).

- **August 2020 → more than 250 cases**
  - Isotonitazene is declining / Brorphine is rising

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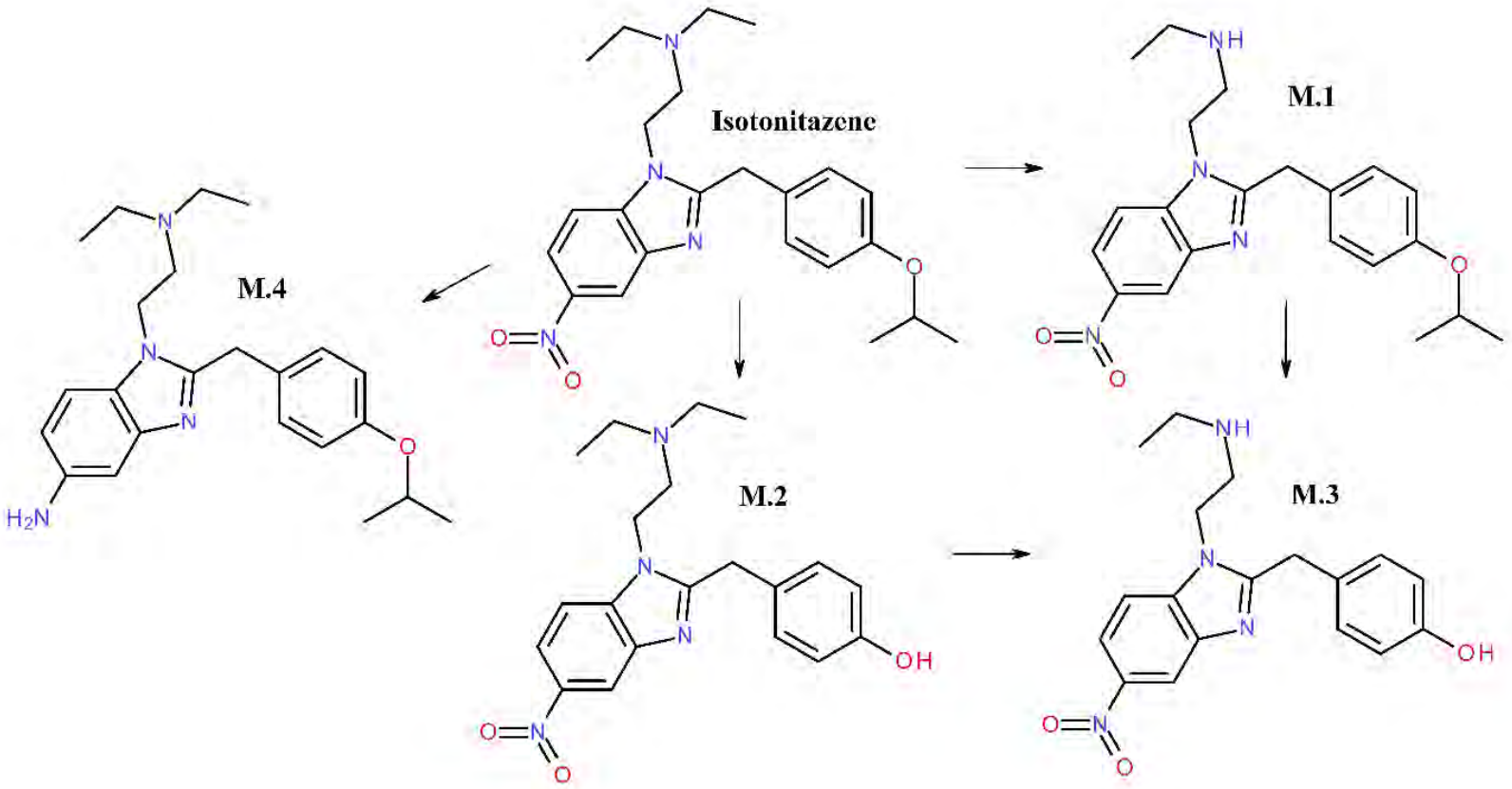
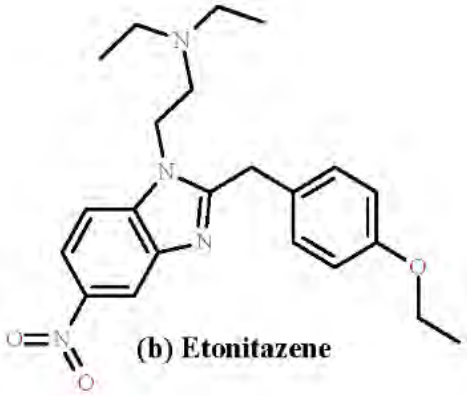
Further Monitoring

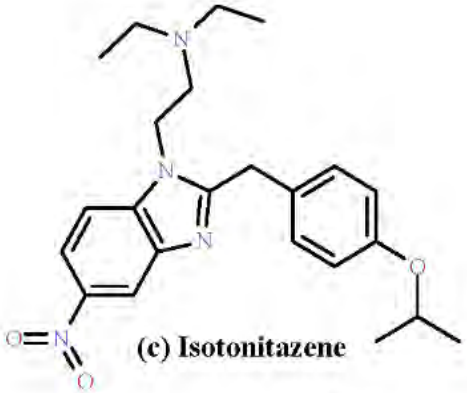


Intelligence / Forecasting

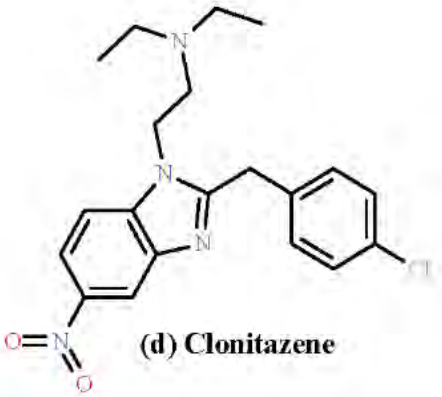
(a) Metonitazene



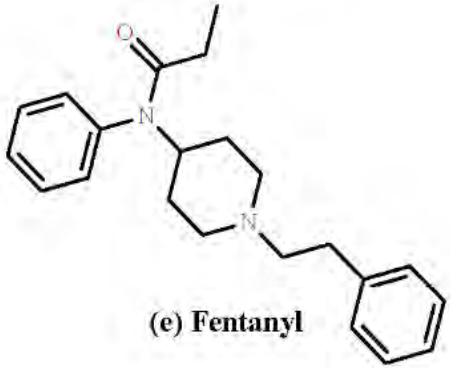
(b) Etonitazene



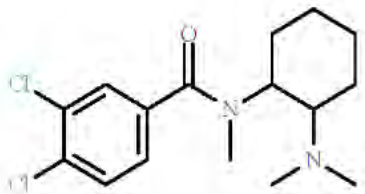
(c) Isotonitazene



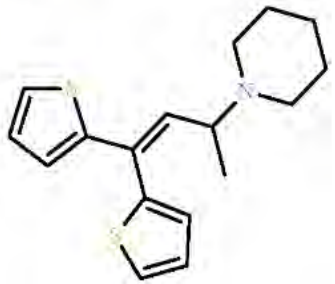
(d) Clonitazene



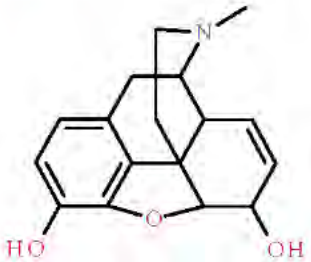
(e) Fentanyl



(f) U-47700

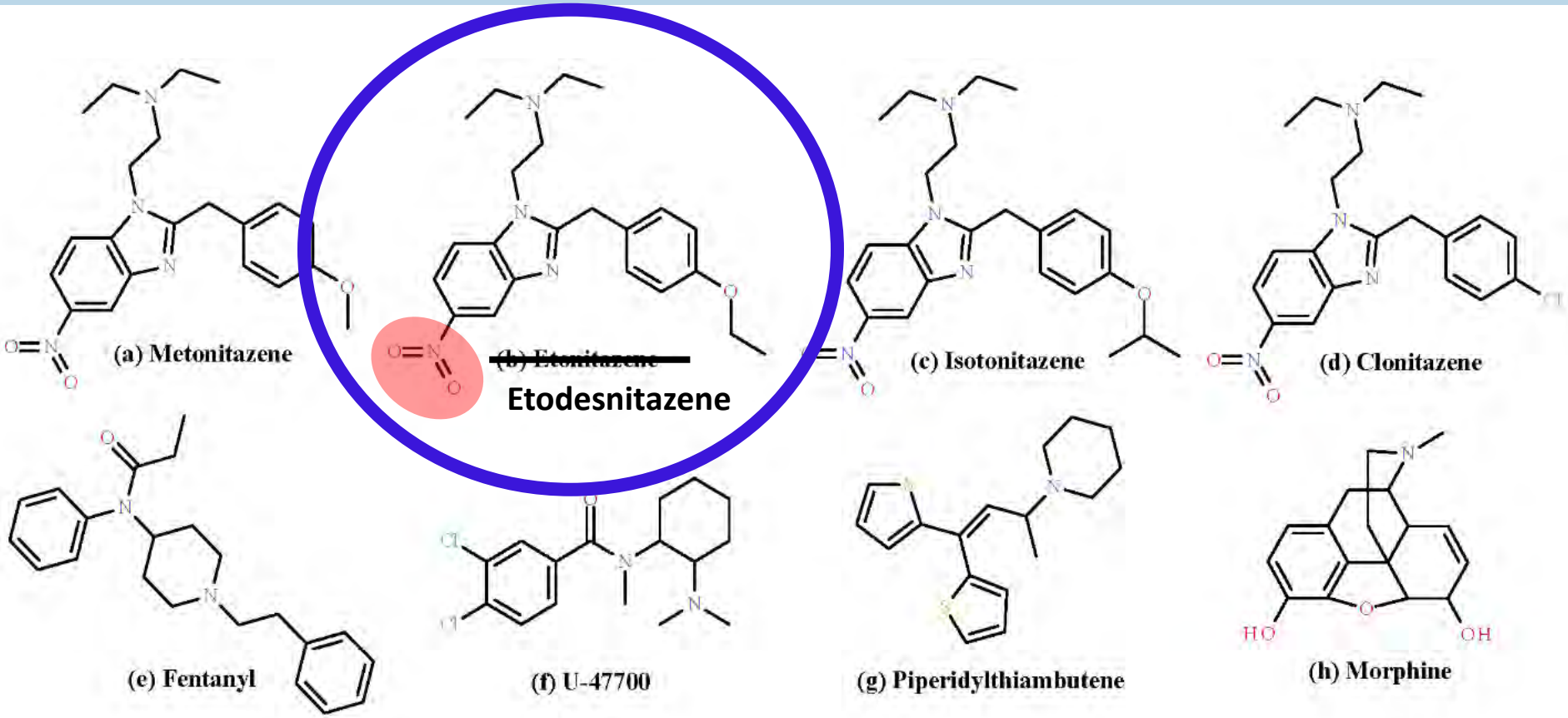


(g) Piperidylthiambutene



(h) Morphine

Intelligence / Forecasting



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doi: 10.1093/jat/bkaa016
Article

OXFORD

Article

Isotonitazene Quantitation and Metabolite Discovery in Authentic Forensic Casework

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Current NPS Trends

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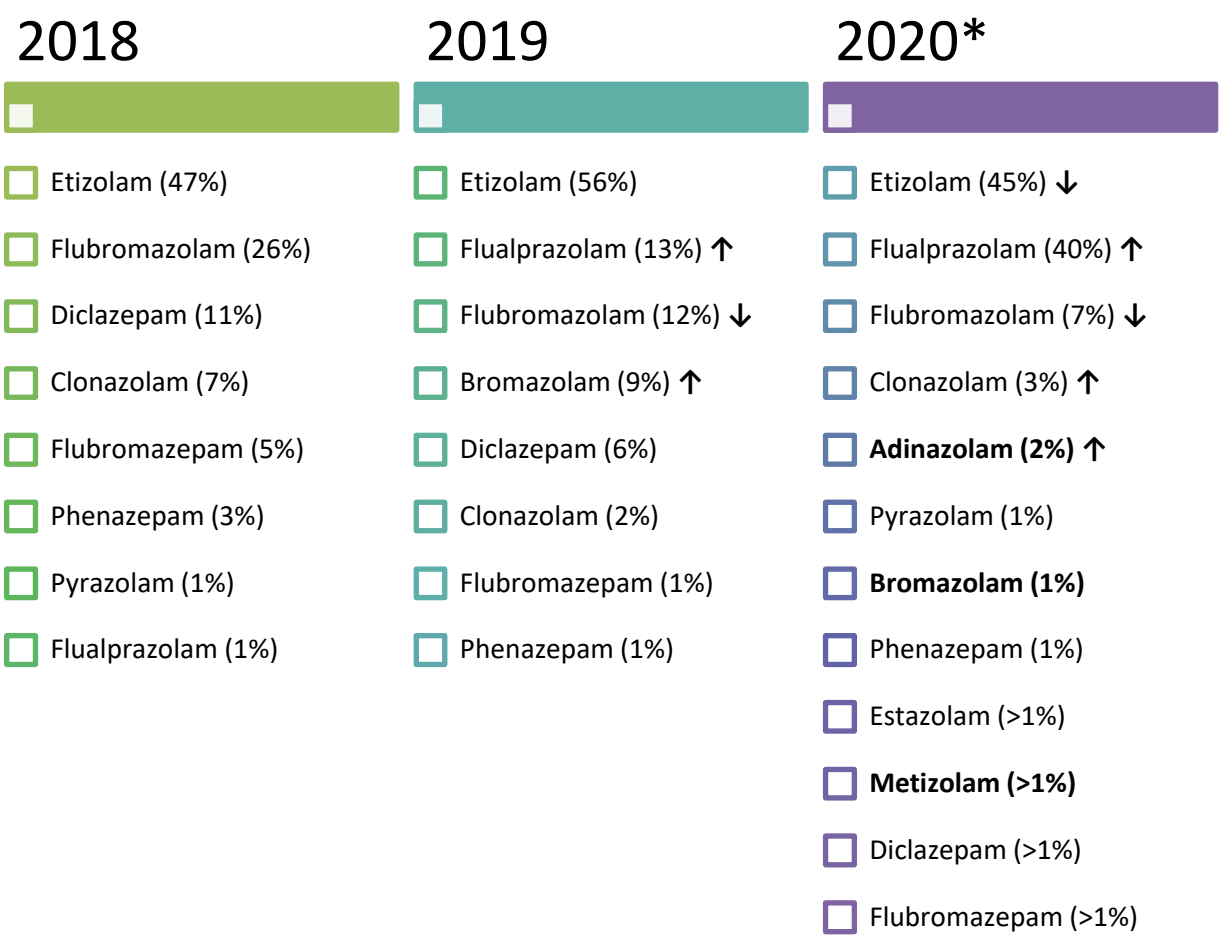
NPS Benzodiazepines



*Only 8 months
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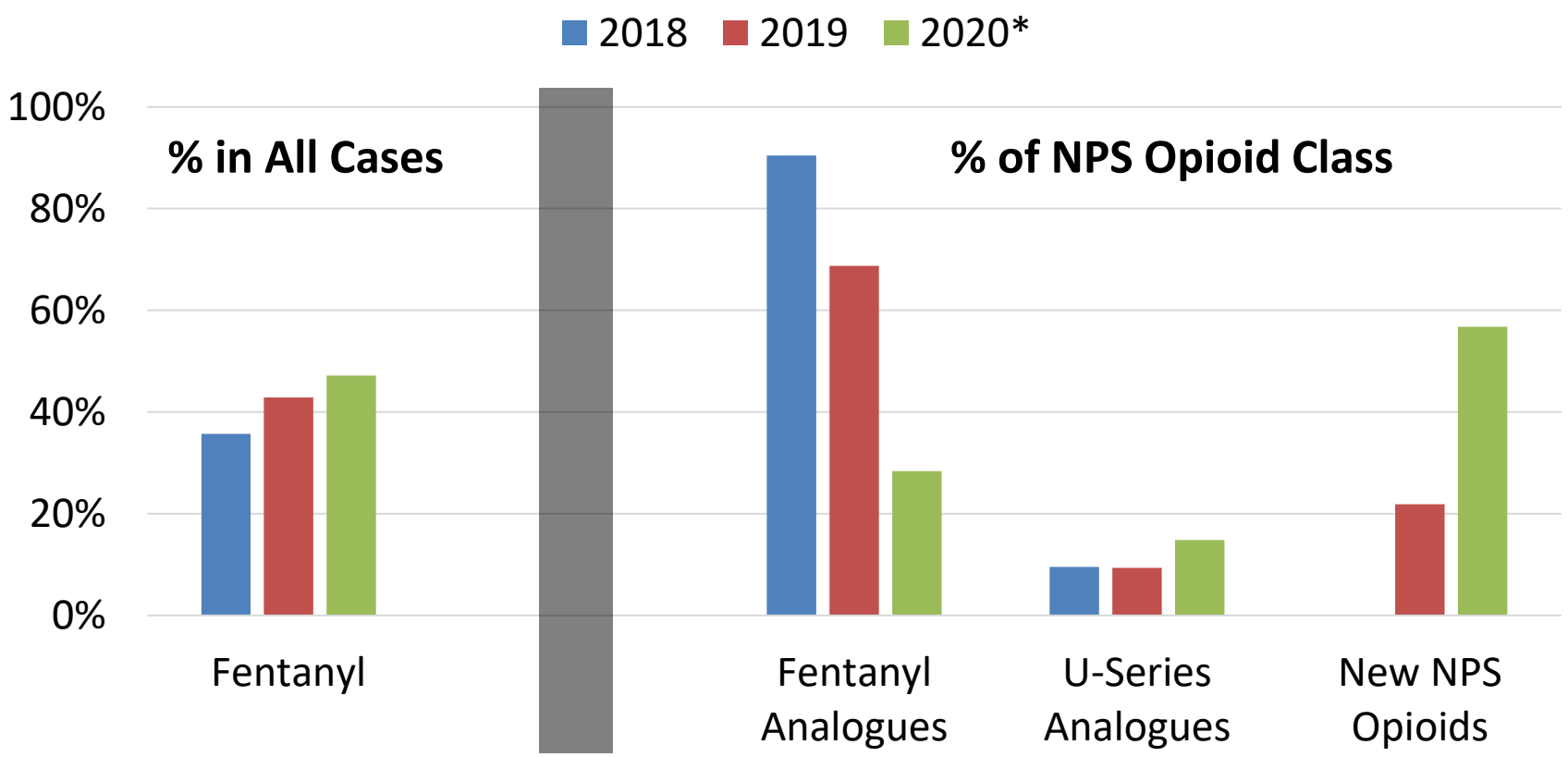
NPS Opioids



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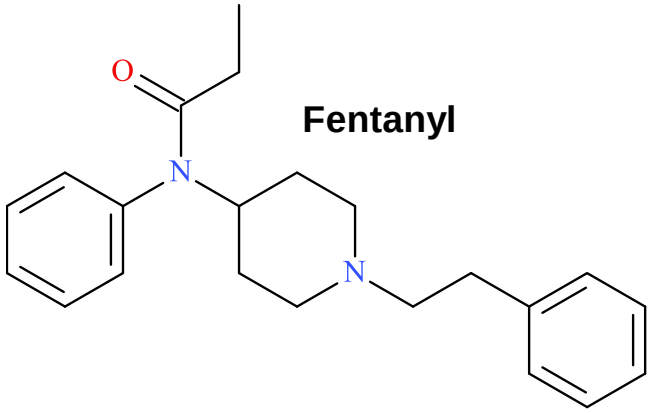
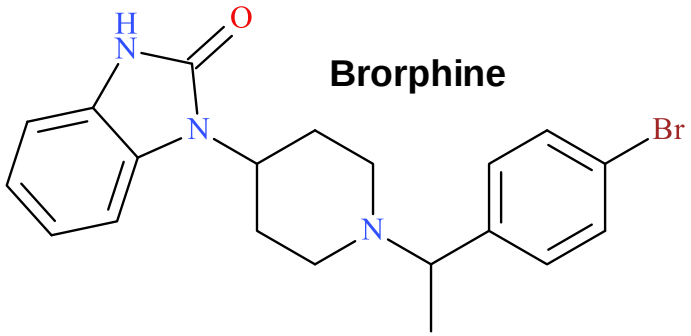
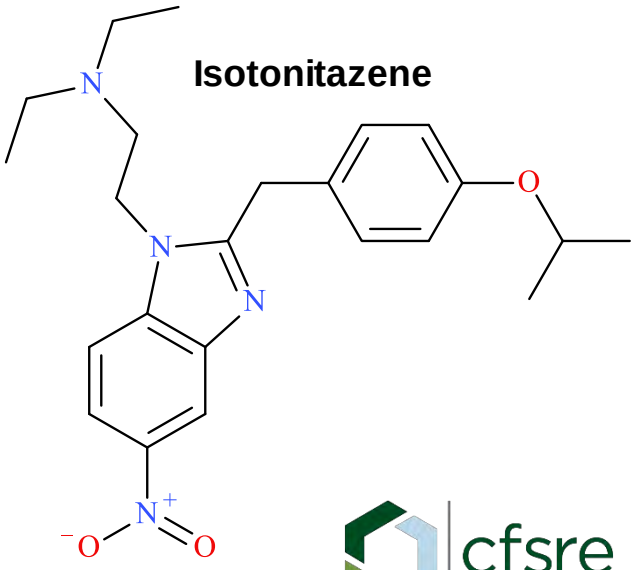
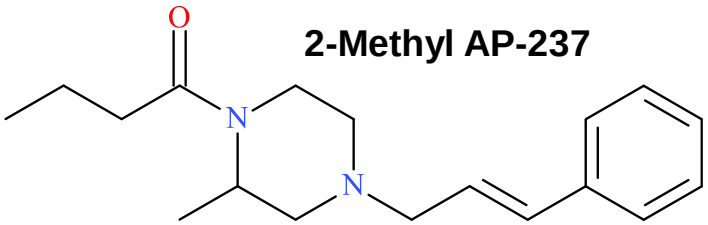
NPS Opioids









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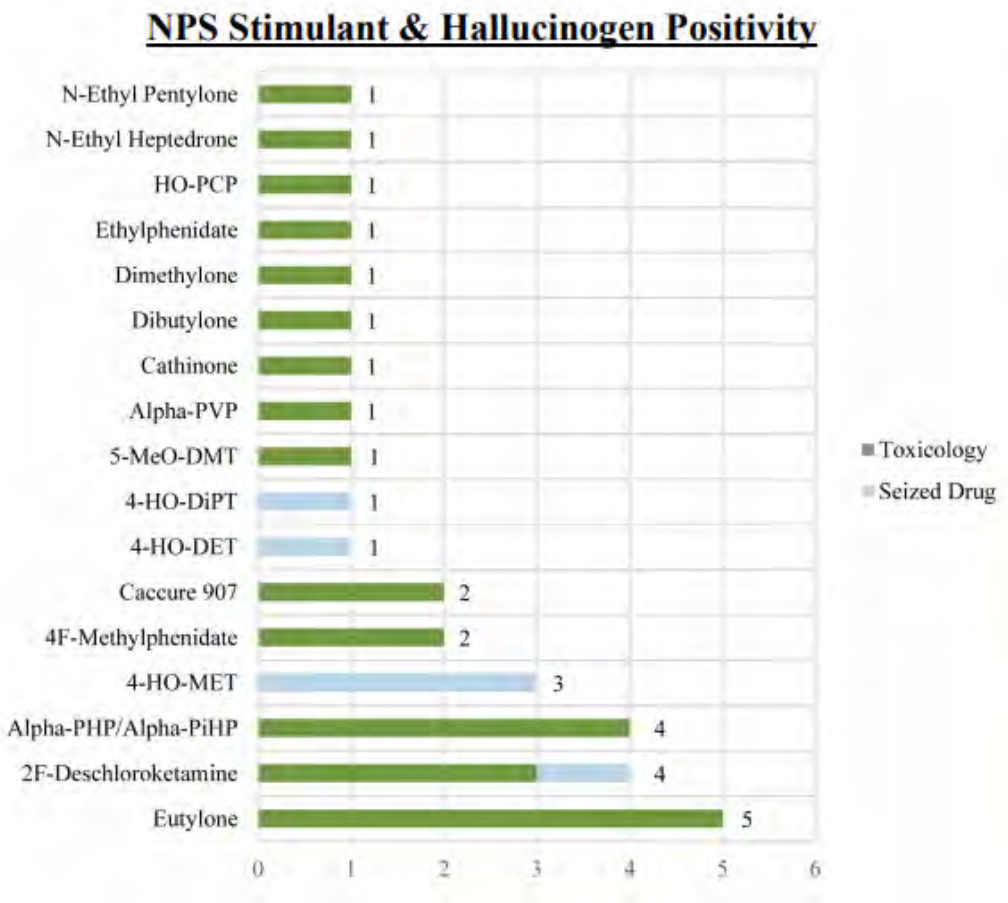
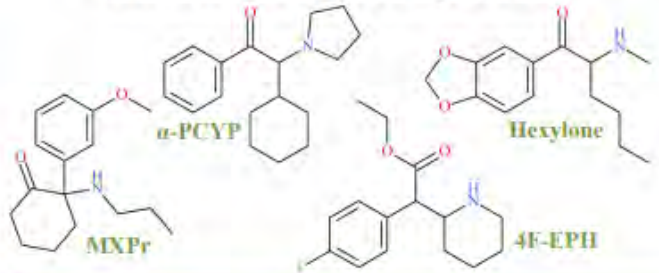
NPS Stimulants / Hallucinogens



NPS Stimulant Combinations

Combination	Frequency
Eutylone + Etizolam + Fentanyl + Cocaine	1
Eutylone + Etizolam + Cocaine	1
Eutylone + Fentanyl + Cocaine	1
Eutylone + Fentanyl	1

New Discoveries in Q2 2020



Acknowledgements: This report was prepared by Alex J. Krotulski, PhD; Amanda L.A. Mohr, MSFS, D-ABFT-FT; and Barry K. Logan, PhD, F-ABFT at the Center for Forensic Science Research and Education (CFSRE) at the Fredric Rieders Family Foundation. NPS Discovery would like to acknowledge staff and scientists at CFSRE and NMS Labs for their involvements and contributions. For more information about our programs and reports, please contact NPS Discovery at npsdiscovery@cfsre.org or visit our website at www.npsdiscovery.org.

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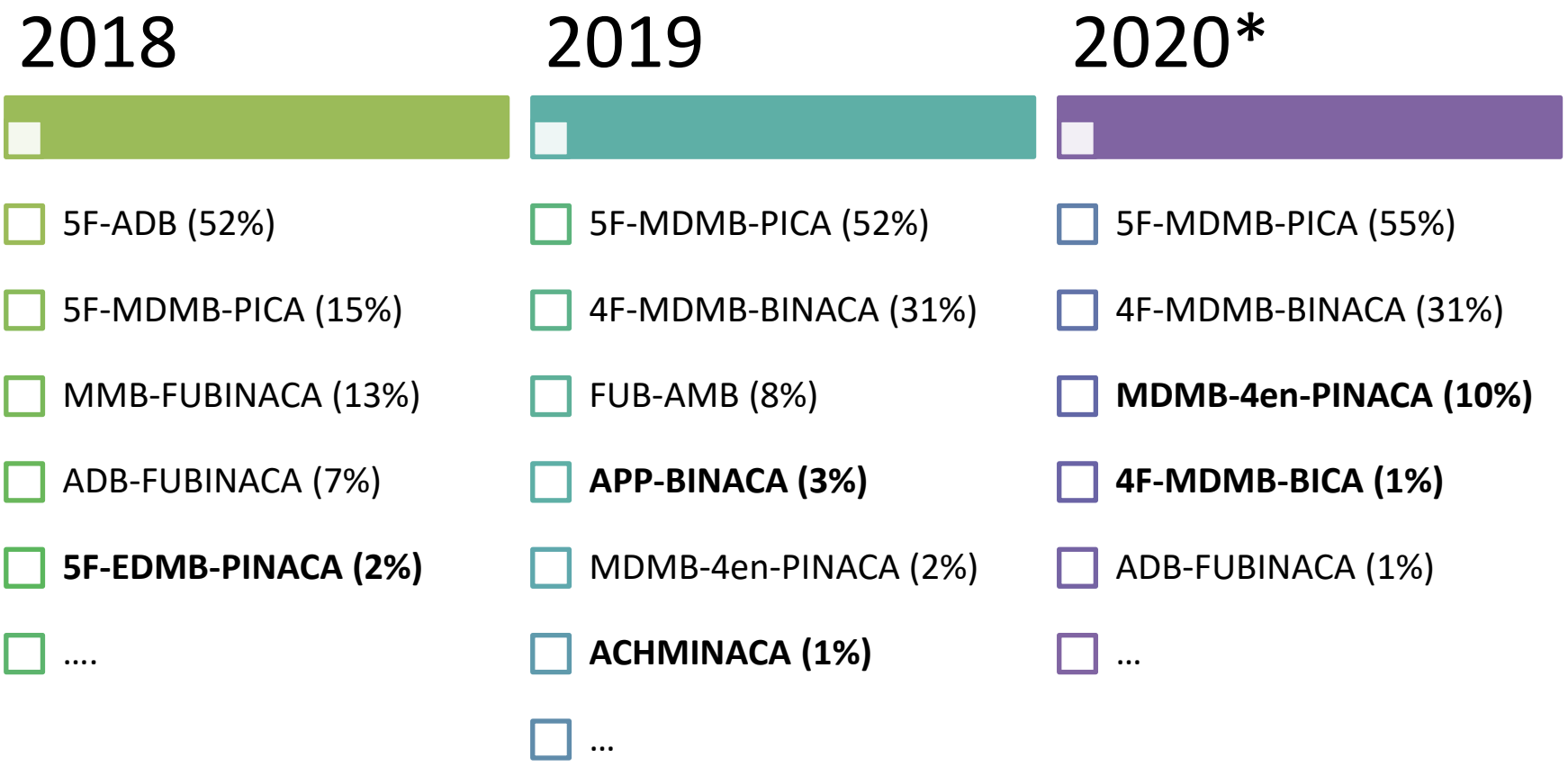
Synthetic Cannabinoids



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Conclusions

What Is The Impact?

- Notifying scientific community
  - Forensic Scientists – Toxicologist and Chemists
  - Medical Examiners / Coroners
  - Physicians / Medical toxicologists
- Alerting public health and drug users
- Rapidly expanding knowledge about NPS
- Effecting drug scheduling and law enforcement

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Conclusions

- The NPS landscape in the U.S. (and around the world) remains dynamic and fluid
- LC-QTOF-MS is the right instrument for the job, but the instrument isn't everything …
- Sample-mining and data-mining workflows are key
  - … So it testing the right sample populations
- Relying on standard reference material

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  - Mandi Mohr
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  - Barry Logan
  - Donna Papsun
  - Sherri Kacinko

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Questions?

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