Impairment and Fatalities Associated with Synthetic Cannabinoids

Barry K Logan PhD, F-ABFT
Executive Director, CFSRE
VP Forensic Sciences, NMS Labs
'Fake weed' overdoses overwhelm Lehigh Valley hospitals

"The pediatric [intensive care unit] has been inundated with these patients," Katz said.

LVHN is seeing a mix of symptoms, he said — intermittent episodes where the patients are very sleepy, almost unresponsive, followed by agitation and even seizures.

"They are screaming, kicking, hard to control," Katz said. "They are essentially delirious. They don't know what's going on."

“Lancaster Police say five people are lucky to be alive after overdosing on synthetic marijuana Monday night. Around 7:00 p.m., the Lancaster Police Department and Lancaster EMS responded to a medical call of someone having a seizure on the 400 block of N. Madison Street.”

Sept 1, 2015
Sheriff: ‘Matter of time’ until ‘Darth Vapor’ OD death

LUDINGTON, Mich. (WOOD) — Monday afternoon, the Mason County Sheriff’s Office was called to the Journey Junior/Senior High School just outside of Ludington for a medical situation.

“When they arrived, they found a 19-year-old student who was actively involved in a seizure,” Mason County Sheriff Kim Cole said.
Adverse Effects
Adverse Effects

- **Cardiovascular**
  - Hypertension
  - Tachycardia

- **Gastrointestinal**
  - Vomiting

- **Neurological**
  - Agitation
  - Confusion
  - Hallucinations
  - Seizures

- **Other Effects**
  - Headache
  - Muscle
  - Numbness
  - Slurred speech
  - Syncope
  - Vomiting
  - Tremors
  - Drowsiness
### Table 6. Case series with large populations with mixed or no toxicological confirmations

<table>
<thead>
<tr>
<th>$n$</th>
<th>Patient information</th>
<th>Adverse effects</th>
<th>Ref.</th>
</tr>
</thead>
</table>
| 464 | Male 73.9%; female 25.4%; unk. 0.6% | Cardiovascular (43.5%)
|     |                     | Slow heart rate (1.5%); chest pain (6.7%); low blood pressure (2.2%); high blood pressure (9.7%); conduction disturbance/dysrhythmia/electrocardiogram change (1.7%); increased heart rate (37.3%) | [29] |
|     | ≤19 years 40.9%; ≥20 years 57.3%; unk. 1.7% | Dermal (2.6%)
|     |                     | Edema (0.2%); erythema — redness of skin (0.2%); hives (0.2%); irritation/pain (0.4%); pallor (1.3%); itchy skin (0.2%); rash (0.2%) |
|     |                     | Gastrointestinal (21.1%)
|     |                     | Abdominal pain (1.1%); anorexia/weight loss (0.4%); dehydration (0.2%); diarrhea (0.6%); vomiting blood (0.2%); nausea (9.9%); throat irritation (0.2%); vomiting (15.7%) |
|     |                     | Hematological (0.4%)
|     |                     | Abnormal bilirubin (0.2%); abnormal liver function test (0.2%) |
|     |                     | Neurological (61.9%)
|     |                     | Agitation (18.5%); uncoordinated movement (2.2%); coma (1.5%); confusion (9.1%); dizziness (8.6%); drowsiness (18.5%); hallucinations (10.8%); sustained muscle contraction (0.2%); headache (3.0%); muscle weakness (0.9%); numbness (1.5%); paralysis (0.2%); seizures (3.7%); slurred speech (1.7%); loss of consciousness (1.9%); tremors (3.9%); ocular (5.0%); blurred vision (0.4%); irritation/pain (0.2%); constriction of the pupil (0.2%); dilated pupils (2.8%); involuntary eye movements (0.6%) |

Gurney et al, 2014.
# Toxicology Review

**Table 8. Summary of case reports of adverse effects with quantitative analysis**

<table>
<thead>
<tr>
<th>Product</th>
<th>$n$</th>
<th>Patient information</th>
<th>Patient sample</th>
<th>Drug detected</th>
<th>Drug conc. (ng/mL)</th>
<th>Adverse effects</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke</td>
<td>2</td>
<td>33-year-old female</td>
<td>Serum</td>
<td>JWH-018</td>
<td>8.1</td>
<td>Sedation, sickness, dry mouth</td>
<td>[96]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time since smoking</td>
<td>5 min</td>
<td>JWH-018</td>
<td>4.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 min</td>
<td>JWH-018</td>
<td>1.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.33 h</td>
<td>JWH-018</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 h</td>
<td>JWH-018</td>
<td>0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6 h</td>
<td>JWH-018</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24 h</td>
<td>JWH-018</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>48 h</td>
<td>JWH-018</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>47-year-old male</td>
<td>Blood</td>
<td>5 min</td>
<td>JWH-018</td>
<td>10.2</td>
<td>Hot flushes, burning eyes, thought disruption, increased pulse, residual tiredness lasting 6–12 h</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time since smoking</td>
<td>10 min</td>
<td>JWH-018</td>
<td>6.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.33 h</td>
<td>JWH-018</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 h</td>
<td>JWH-018</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6 h</td>
<td>JWH-018</td>
<td>0.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>24 h</td>
<td>JWH-018</td>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>48 h</td>
<td>JWH-018</td>
<td>Not present</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8. (Continued)

<table>
<thead>
<tr>
<th>Product</th>
<th>n</th>
<th>Patient information</th>
<th>Patient sample</th>
<th>Drug detected</th>
<th>Drug conc. (ng/mL)</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>“BooM”</td>
<td>1</td>
<td>14-year-old female</td>
<td>Blood</td>
<td>JWH-210</td>
<td>4</td>
<td>Inappropriate freezing, enlarged pupils</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JWH-122</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>“BooM”</td>
<td>1</td>
<td>14-year-old female</td>
<td>Blood</td>
<td>JWH-210</td>
<td>0.80</td>
<td>Unconscious, confused speech, instable appearance</td>
</tr>
<tr>
<td>Not provided</td>
<td>1</td>
<td>20-year-old male</td>
<td>Blood</td>
<td>JWH-019</td>
<td>1.7</td>
<td>Confused speech, instable appearance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80 min after use</td>
<td></td>
<td>JWH-122</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JWH-210</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AM-2201</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>“BooM” and motor “OMG”</td>
<td>1</td>
<td>29-year-old male</td>
<td>Blood</td>
<td>JWH-210</td>
<td>6.2</td>
<td>Vestibular disorder, disturbance to fine skill, enlarged pupils, blunt mood</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 min after use</td>
<td></td>
<td>JWH-122</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Not provided</td>
<td>1</td>
<td>21-year-old male</td>
<td>Blood</td>
<td>JWH-018</td>
<td>0.52</td>
<td>Enlarged pupils, delayed reaction of pupils to light, retarded behaviour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>81 min after use</td>
<td></td>
<td>JWH-122</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JWH-210</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td>Not provided</td>
<td>1</td>
<td>21-year-old</td>
<td>Blood</td>
<td>JWH-307</td>
<td>1.1</td>
<td>Delayed reactions, retarded movement sequence, nervous, constricted pupil, no reaction to light, depressed mood</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blood alcohol</td>
<td>1.74%</td>
<td></td>
</tr>
<tr>
<td>Not provided</td>
<td>1</td>
<td>22-year-old</td>
<td>Blood</td>
<td>AM-2201</td>
<td>&lt;0.1</td>
<td>Impaired driving, retarded movement sequence, apathetic, nervous, delayed reaction of pupils to light, death</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 h 35 min after use</td>
<td></td>
<td>JWH-018</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JWH-122</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JWH-210</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>JWH-307</td>
<td>&lt;0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MAM-2201</td>
<td>&lt;0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>UR-144</td>
<td>&lt;0.1</td>
<td></td>
</tr>
</tbody>
</table>
Synthetic Cannabinoids Market

Synthetic Cannabinoids in Blood

% Positive Samples

Any Analyte
JWH-018
JWH-073
JWH-250
AM-2201
JWH-122
JWH-210
UR-144
XLR-11
AB-CHMINACA
AB-FUBINACA
AD8-CHMINACA

Synthetic Cannabinoids Market
Impairment
“The driver in a deadly weekend crash that has devastated a local family was under the influence of synthetic marijuana, also known as “spice,” according to the CHP”.

Oct 25, 2014
Intoxication – Syn Canns

“OKLAHOMA CITY – A local school bus driver who crashed into multiple cars in southeast Oklahoma City, leaving three people hospitalized, was reportedly high on synthetic marijuana at the time.

April 22, 2015
Blood synthetic cannabinoid concentrations in cases of suspected impaired driving.

- 12 cases of Suspected impaired driving involving synthetic cannabinoids.
- Attitude of the drivers was cooperative and relaxed, speech was slow and slurred, coordination was poor.
- Pulse and blood pressure were generally elevated.
- The most consistent sign noted was a marked lack of convergence in all cases where it was assessed.
- JWH-018 (n=4) 0.1-1.1ng/mL; JWH-081 (n=2) qualitative only; JWH-122 (n=3) 2.5ng/mL; JWH-210 (n=4) 0.1ng/mL; JWH-250 (n=1) 0.38ng/mL; AM-2201 (n=6) 0.43 – 4.0ng/mL.
Driving Case Studies

Concentrations of APINACA, 5F-APINACA, UR-144 and its Degradant Product in Blood Samples from Six Impaired Drivers Compared to Previous Reported Concentrations of other Synthetic Cannabinoids.

Tuv et al. Forensic Science Int. 2015 Jan; 246:980103

- AM-2201, APINACA, 5F-APINACA, UR-144 and UR-144 DUID cases.
- Reporting APINACA and 5F-APINACA in concentrations from 0.24 to 24.5 and 0.9 to 6.5 μg/L, respectively, and UR-144 in two cases in concentrations of 0.22 and 0.47 μg/L.
Conclusions

- General agreement that the effects on behavior and performance and driving are similar to those reported for marijuana.
- Elevated pulse blood pressure, cognitive and psychomotor effects
- Effect profile can include more serious adverse events including paranoia, delusions and anxiety.
- Concentrations on drugs are in the low ng/mL range
- Scope of drugs tests changes rapidly and dramatically creating a challenge for labs to keep up.
- Increasing numbers of cases reports with similar findings support the need to consider synthetic cannabinoids when THC has been ruled out.
Deaths
Coroner: Lamar Jack ingested chemical found in fake marijuana before he died

“Anderson University basketball player Lamar Jack died after ingesting a chemical that is a key ingredient in synthetic marijuana, the county corner said Saturday.”
Three cases of myocardial infarction in teenagers (males, 13, 16, 16) after smoking K2.

Patients presented complaining of chest pain within three days of smoking the drug.

Acute MI diagnosed based on ECG and elevated troponin.

Coronary angiography normal for two of the three patients.

Note: No toxicological confirmation of use.

Mir A, Obafemi A, Young A, Kane C: Myocardial Infarction Associated With Use of the Synthetic Cannabinoid K2; Pediatrics 128:e1622–e1627, 2011
A fatal case of MAM-2201 poisoning

Takeshi Saito · Akira Namera · Naoya Miura ·
Shigenori Ohta · Shota Miyazaki · Motoki Osawa ·
Sadaki Inokuchi

“A 59-year-old man was found dead in his house, where three sachets containing herbal blends with MAM2201 were found on a table.

There were neither external injuries nor endogenous diseases judged by macroscopic and microscopic observations.

The MAM-2201 concentrations were: 12.4 ng/ml in whole blood; 18.1 ng/g in the liver; 11.2 ng/g in the kidney; 4.3 ng/g in the brain; and 1,535 ng/g in the adipose tissue. We concluded that the man’s death was caused by acute intoxication with MAM-2201.”
CASE REPORT

TOXICOLOGY, PSYCHIATRY & BEHAVIORAL SCIENCE

Amy L. Patton,¹ B.S.; Krishna C. Chimalakonda,² Ph.D.; Cindy L. Moran,³ B.S.; Keith R. McCain,⁴ Pharm.D.; Anna Radominska-Pandya,² Ph.D.; Laura P. James,⁵ M.D.; Charles Kokes,³ M.D.; and Jeffery H. Moran,¹,² Ph.D.

K2 Toxicity: Fatal Case of Psychiatric Complications Following AM2201 Exposure*†
Synthetic Cannabinoid Deaths


- Identification and quantitation of 5F-PB-22 in four postmortem cases.
- The observed concentration range of 5F-PB-22 were 1.1-1.5 ng/mL
- Three of the decedents experienced abrupt, sudden collapse and death; however, one decedent expired after a rapidly deteriorating hospital course with fulminant liver failure.
- Deaths certified as synthetic cannabinoid intoxication, accidental deaths.
Acute Delirium


- 35 patients between 28 May and 8 June 2014
- All used product from same source
- Acute delirium – 24 patients
- Seizures – 14 patients
- Ventilator support/ICU care – 5 patients
- No Deaths
Over the past three weeks, people have been tumbling into emergency rooms across the country, seriously ill after using a synthetic drug known as K2 or spice.

Hundreds of cases have been reported in states including Alabama, Mississippi and New York, where state health departments have warned people to stay away from the drug. New York City alone saw over 120 emergency cases in a single week in April.
Severe Illness

Kasper et al, Notes from the Field: Severe Illness Associated with Reported Use of Synthetic Cannabinoids — Mississippi, April 2015. MMWR October 9, 2015 / 64(39);1121-2

- April 2, 2015 – 4 patients presented at hospital with agitated delirium
- April 3-6 – 24 additional patients at same hospital
Severe Illness - cont

- April 5 – Statewide alert requesting providers report any case with two or more of the following symptoms: sweating, severe agitation, or psychosis in a person with known or suspected synthetic cannabinoid use.
- April 13 – Second Alert
- April 21 – approximately 400 cases reported
- April 2 to May 3, 2015: 721 suspected cases – 9 deaths
Severe Illness - cont

- 119 cases treated at one hospital
- Age 14 – 62 (median = 31 years)
- 12 patients admitted to ICU
- 3 deaths
- At time of MMWR – 10 tested positive for ADB-CHMINACA; 75 pending analysis.
- Mississippi cases part of a larger multi-state outbreak
How are Medical Examiners Using Positive Synthetic Cannabinoid Results in Certifying Deaths?

- Participation was solicited via the NAME list serve.
- Responders provided demographic, investigative, autopsy, and death certification information.
- When required, additional toxicology testing was performed at NMS Labs.
Synthetic cannabinoid drug use as a cause or contributory cause of death

Laura M. Labay\textsuperscript{a,*}, James L. Caruso\textsuperscript{b}, Thomas P. Gilson\textsuperscript{c}, Rebecca Jufer Phipps\textsuperscript{d}, Laura D. Knight\textsuperscript{e}, Nikolas P. Lemos\textsuperscript{f}, Iain M. McIntyre\textsuperscript{g}, Robert Stoppacher\textsuperscript{h}, Lee Marie Tormos\textsuperscript{i}, Andrea L. Weins\textsuperscript{j}, Erica Williams\textsuperscript{k}, Barry K. Logan\textsuperscript{a}

\textsuperscript{a} NMS Labs, 3701 Welsh Rd, Willow Grove, PA, United States
\textsuperscript{b} City and County of Denver, 680 Bannock Street, Denver, CO, United States
\textsuperscript{c} Cuyahoga County Regional Forensic Science Laboratory, 11001 Cedar Avenue, Cleveland, OH, United States
\textsuperscript{d} Office of the Chief Medical Examiner, 900W. Baltimore Street, Baltimore, MD, United States
\textsuperscript{e} SUNY Upstate Medical University, Syracuse, NY, United States
\textsuperscript{f} Department of Laboratory Medicine, School of Medicine, University of California, San Francisco, United States
\textsuperscript{g} San Diego County Medical Examiner’s Department, San Diego, CA, United States
\textsuperscript{h} Onondaga County Medical Examiner’s Office, 100 Elizabeth Blackwell Street, Syracuse, NY, United States
\textsuperscript{i} Medical University of South Carolina, 181 Ashley Avenue MSC 908, Charleston, SC, United States
\textsuperscript{j} Oklahoma Office of the Chief Medical Examiner, 1115 West 17th Street, Tulsa, OK, United States
\textsuperscript{k} Coroner’s Offices, Chester and Montgomery Counties, PA, United States
A. CASE BACKGROUND AND INVESTIGATION

1. Case Identifier (e.g. your case number): 1402244
2. Age: 41
3. Gender: Male
4. Date of death: 05-17-14
5. City and State of death: Pauls Valley, Oklahoma
6. Brief history of events surrounding death:
   DECEASED IS A WHITE MALE WHO WAS FOUND UNRESPONSIVE IN THE
   RESIDENCE BY HIS GIRLFRIEND. EMS ARRIVED AND HE WAS PRONOUNCED. NO
   TRAUMA NO FOUL PLAY SUSPECTED. THE DECEASED HAS BEEN ON A SYNTHETIC
   SUBSTANCE CALLED K-2 FOR AWHILE. THE DECEASED USED TO SMOKE
   MARIJUANA AND NOW HE IS USING THE K-2. THERE WERE SEVERAL PACKAGES
   THAT THE SHERIFF'S OFFICE CONFISCATED FROM THE RESIDENCE. THE DECEASED
   WAS FOUND ON THE BED WITH FLUID PRESENT FROM HIS NOSE AND MOUTH.
   IT APPEARS THAT HE MAY HAVE INGESTED TOO MUCH OF THE DRUGS.
7. Drug use history: marijuana, K2
8. Photographs of any drug packets, products or paraphernalia [attach or paste] attached.....
9. Any lab reports of analysis of seized drug material found at the scene or
determined to be related to the case [attach]. None
   ▪ Note: If drug material was seized but not analyzed, you can submit to the
   Foundation for testing at no charge. Contact Mandi Arntson at (215) 366
   1545, marntson@frfoundation.org to arrange.
10. Other relevant information:

B. PATHOLOGY and TOXICOLOGY FINDINGS

1. Determinative Pathology Findings
   ▪ Pulmonary edema
   ▪ Significant atherosclerosis of one of the coronary arteries (75 %
oclusion, left anterior descending).
   ▪ Significant anthracosis of the lungs (apparent smoking).
   ▪ Remaining organs examined were grossly unremarkable.

2. Toxicology Findings
   ▪ Ethanol: Heart blood: 0.08% w/v  Vitreous: 0.10% w/v
   ▪ Morphine (free): 0.16 mcg/mL Femoral blood
   ▪ 6 acetyl morphine; none detected in urine
   ▪ Oxycodone: 0.17 mcg/mL Femoral blood
   ▪ Diphenhydramine and doxylamine detected

3. Cause and Manner of Death per death certificate
   Acute multi drug toxicity; Accident

4. Other relevant information
Contributions of SC to Death

Syn Cann Mono Intoxication
- Syn Cann only relevant drug identified that contributed to death.

Syn Cann Combined Drug Intoxication
- Mixed drug intoxication including synthetic cannabinoids

Behavioral and Physical Contribution Resulting in Death
- Psychosis and/or excited delirium resulting in restraint followed by death.

Behavioral Contribution Resulting in Death
- Behavior resulting in trauma or injury leading to death.

Contribution Unknown/Natural
- Unclear if/how the presence of a Syn Cann played in role in the death.
Toxicology Profile – Drugs of Abuse

Cannabinoids (Marijuana)
- 4 cases were positive for THC (1.1 - 7 ng/mL) and THCC
- 1 case was positive for THCC
- 1 case was presumptive positive for cannabinoids

Other Recreational Drugs
- Heroin (n=1); morphine: positive
- UR-144 Positive; Amphetamine Positive; Alprazolam Positive; Citalopram/Escitalopram 130 ng/mL; Hydrocodone 26 ng/mL
- Methamphetamine/Amphetamine (n=1); 730 ng/mL/90 ng/mL
- XLR-11 positive
- MDEA/MDA (n=1); 217 ng/mL/111 ng/mL
## Police Custody Deaths

<table>
<thead>
<tr>
<th>Excited Delirium</th>
<th>Case I</th>
<th>Case II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Erratic and aggressive behavior on public street with police arrest and restraint.</td>
<td>Single motor vehicle crash, no significant injuries. Police noted CDS in vehicle, subject fled running half mile.</td>
</tr>
<tr>
<td><strong>Toxicology</strong></td>
<td>JWH-018: 0.11 ng/mL; AM-2201: 2.5 ng/mL; Phenytoin: 8.8 mcg/mL</td>
<td>JWH-210: Positive; Fentanyl: Positive</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>Cardiomegaly with four chamber dilation.</td>
<td>Not Provided</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td>Complications of excited delirium associated with synthetic marijuana use following police arrest and restraint procedures.</td>
<td>Agitated delirium associated with synthetic marijuana use following police arrest and restraint procedures.</td>
</tr>
<tr>
<td><strong>Manner of Death</strong></td>
<td>Undetermined</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

---

**Excited Delirium**

**Case I**

Erratic and aggressive behavior on public street with police arrest and restraint.

**Toxicology**

- JWH-018: 0.11 ng/mL
- AM-2201: 2.5 ng/mL
- Phenytoin: 8.8 mcg/mL

**Pathology**

Cardiomegaly with four chamber dilation.

**Cause of Death**

Complications of excited delirium associated with synthetic marijuana use following police arrest and restraint procedures.

**Manner of Death**

Undetermined

---

**Excited Delirium**

**Case II**

Single motor vehicle crash, no significant injuries. Police noted CDS in vehicle, subject fled running half mile.

**Toxicology**

- JWH-210: Positive
- Fentanyl: Positive

**Pathology**

Not Provided

**Cause of Death**

Agitated delirium associated with synthetic marijuana use following police arrest and restraint procedures.

**Manner of Death**

Unknown
# Behavioral Toxicity ➔ Injury

<table>
<thead>
<tr>
<th>Trauma Injury - Under the Influence</th>
<th>Case I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Decedent consumed a &quot;pot brownie&quot; with a friend. 45 min later the decedent was feeling profound effects and called for assistance. A couple hours later the decedent walked to the fire escape and fell over the barrier. Died 9 days later.</td>
</tr>
<tr>
<td><strong>Toxicology</strong></td>
<td>JWH-175 105ng/mL</td>
</tr>
<tr>
<td></td>
<td>MDEA 0.217mg/L</td>
</tr>
<tr>
<td></td>
<td>MDA 0.111mg/L</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>Subdural hematoma, pelvic fracture, liver laceration, facial fractures, and a compound elbow fracture.</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td>Multiple blunt traumatic injuries. Other Conditions: Acute mixed drug intoxication</td>
</tr>
<tr>
<td><strong>Manner of Death</strong></td>
<td>Accident</td>
</tr>
</tbody>
</table>
# Behavioral Toxicity → Injury

<table>
<thead>
<tr>
<th>Environmental Injury - Under the Influence</th>
<th>Case I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>HBD - Friends at the party described him as intoxicated, but coherent and able to walk. Jumped from a patio, and landed feet first, then crawled under the patio. Reportedly &quot;frozen&quot; immediately after the jump and placed onto a couch. Found unresponsive on the couch later that morning, pronounced.</td>
</tr>
<tr>
<td><strong>Toxicology</strong></td>
<td>AM-2201 0.21ng/mL; JWH-018 0.65ng/mL JWH-122 pos; JWH-210 positive THC 1.1ng/mL THC-COOH 6.0ng/mL EtOH 0.15g/100mL</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>No evidence of head, chest or abdomen injury.</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td>Complications of acute ethanol toxicity, acute synthetic cannabinoid toxicity, possible hypothermia</td>
</tr>
<tr>
<td><strong>Manner of Death</strong></td>
<td>Accident</td>
</tr>
</tbody>
</table>
Mono or Poly Drug Intoxication

- 9 cases with consensus (>67%) for Drug Intoxication
  - 5 Mono* drug intoxication synthetic cannabinoids
  - 2 Poly Drug intoxication involving synthetic cannabinoids
  - 1 equivocal single/poly drug intoxication
- *Mono drug refers to synthetic cannabinoids (class) only.
## Acute Mono Drug Intoxication

<table>
<thead>
<tr>
<th>Mono Drug Intoxication</th>
<th>Case I</th>
<th>Case II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Decedent found lying prone on floor of his bedroom. He was last seen alive at 00:30, then found at 14:22 hours later that day. Decedent reported to have a learning disability.</td>
<td>Went to bathroom to vomit. Had diarrhea. Found unresponsive at 11:15am. Alleged heart condition, but no medication. Hx of alcoholism. Family denies illicit drug use but notes &quot;Spice&quot; use. HBD and smoked spice the night before. Found lying supine on bedroom floor</td>
</tr>
<tr>
<td><strong>Toxicology</strong></td>
<td>JWH-122 positive; JWH-210 positive AM-2201 0.16ng/mL</td>
<td>AM-2201 2.8ng/mL JWH-018 0.11ng/mL</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>The airway contained bloody froth. Cardiomegaly was also noted.</td>
<td>Congestion in lungs, Fatty liver, mild cardiomegaly, COPD, mild ASCVD</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td>Adverse effects of AM-2201, JWH-122 and JWH-210</td>
<td>Drug (synthetic marijuana) toxicity</td>
</tr>
<tr>
<td><strong>Manner of Death</strong></td>
<td>Accident</td>
<td>Accident</td>
</tr>
</tbody>
</table>

**AM-2201**

**JWH-018**

**JWH-122**

**JWH-210**
# Acute Mono Drug Intoxication

<table>
<thead>
<tr>
<th>Mono Drug Intoxication</th>
<th>Case III</th>
<th>Case IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Decedent found prone on bed, clutching a lighter in his left hand. Last known alive at 01:00, when decedent stated he was not feeling well and going to bed. He was found dead later that day at 1630.</td>
<td>Witnessed cardio-pulmonary arrest after earlier use of &quot;Legal Phunk&quot;</td>
</tr>
<tr>
<td><strong>Toxicology</strong></td>
<td>JWH-122 positive JWH-250 0.23ng/mL AM-2201 7.3ng/mL</td>
<td>JWH-122 positive</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>Decedent was obese with possible hx of sleep apnea. Foam in external nares, with pulmonary edema</td>
<td>None</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td>Adverse effects of drugs (synthetic cannabinoids)</td>
<td>Sudden death associated with synthetic cannabinoid use.</td>
</tr>
<tr>
<td><strong>Manner of Death</strong></td>
<td>Accident</td>
<td>Accident</td>
</tr>
</tbody>
</table>
# Acute Mono Drug Intoxication

<table>
<thead>
<tr>
<th>Mono Drug Intoxication</th>
<th>Case V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Found unresponsive in bathroom by family member after vomiting on 3/27/12. In hospital, he developed anoxic brain injury, then died.</td>
</tr>
</tbody>
</table>
| **Toxicology**         | JWH-122 positive  
|                        | JWH-210 positive  
|                        | AM-2201 0.22ng/mL |
| **Pathology**          | None reported  |
| **Cause of Death**     | Anoxic brain injury due to synthetic cannabinoid toxicity |
| **Manner of Death**    | Accident |
# Acute Poly Drug Intoxication

<table>
<thead>
<tr>
<th>Poly Drug Intoxication</th>
<th>Case I</th>
<th>Case II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Collapsed on a public street. Decedent is alleged to have ingested alcohol and drugs. Puncture wound in left antecubital fossa.</td>
<td>Decedent found unresponsive in bedroom lying face up on bed, clutching a bag of candy in left hand. A towel had been placed up against the crack at the bottom of the bedroom door. Decedent last known alive at 00:36 and was found at 08:09 the same day.</td>
</tr>
<tr>
<td><strong>Toxicology</strong></td>
<td>XLR-11 positive UR-144 positive Alcohol 0.03%</td>
<td>JWH-018 positive THC 7ng/mL, THCOOH 17ng/mL Alcohol 0.013%</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td>None</td>
<td>Heavily congested lungs, Vomitus noted in upper airway, Aspiration pneumonia and pneumonitis with bronchiolar foreign material and patchy alveolar hemorrhage</td>
</tr>
<tr>
<td><strong>Cause of Death</strong></td>
<td>Synthetic cannabinoid and alcohol toxicity</td>
<td>1) Drug intoxication (ethanol, THC, JWH-018) 2) Aspiration pneumonia</td>
</tr>
<tr>
<td><strong>Manner</strong></td>
<td>Accident</td>
<td>Accident</td>
</tr>
</tbody>
</table>
## Syn Cann Toxic Effects

<table>
<thead>
<tr>
<th>Organ System Affected</th>
<th>Symptoms and Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Nervous System</td>
<td>Agitation, psychosis, irritability, seizures, coma, sedation, delirium, hallucinations, paranoia, anxiety, self-harm, psychomotor impairment,</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Tachycardia, hypertension, acute coronary syndrome, arrhythmia, chest pain, myocardial infarction</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Tachypnea, diffuse alveolar hemorrhages</td>
</tr>
<tr>
<td>Other</td>
<td>Nausea, vomiting, fevers, mydriasis, lack of convergence, acute kidney injury, hyperglycemia, hypokalemia, fighting, restraint</td>
</tr>
</tbody>
</table>

Questions and Discussion

barry.logan@nmslabs.com