Recommendations for Toxicological Investigation of Drug-Impaired Driving and Motor Vehicle Fatalities

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Project Background

• In 2004, a group convened to identify problems with the current system of prosecuting impaired driving cases, from the point of detection through adjudication
  • Toxicologists, Drug Recognition Experts (DREs), prosecuting attorneys
  • Identified lack of consistency of practice among laboratories

• Beginning in 2004, the National Safety Council (NSC) began documenting analytical practices of toxicology laboratories in driving under the influence of drugs (DUID) cases
  • Looked at screening and confirmation scope as well as cutoffs
  • Recommendations were published in 2007
    • Most frequently encountered analytes in DUID investigations
    • Minimum menu of drugs which should be tested for
    • Based on availability of immunoassay screening technology and standard instrumentation available to most laboratories
2007 Recommendations

Initial Survey

- Survey sent to laboratories to gather information
  - Questions related to analytical scope and cutoffs and most frequently encountered drugs in driving under the influence of drugs (DUID) casework
    - 42 laboratories in 24 states
      - City, county, state, and private laboratories
      - 66% were states with an active DRE program
### Initial Survey Findings

#### Screening
- 100% of laboratories used immunoassay to screen blood and urine specimens
- 41% of laboratories had one or more additional techniques to increase scope for screening
  - High performance liquid chromatography (HPLC)
  - Gas chromatography (GC) with various detectors
  - Liquid chromatography/mass spectrometry (LC/MS)

#### Confirmation
- 100% of laboratories performed confirmatory analysis by gas chromatography/mass spectrometry (GC/MS)
- 22% used additional techniques
  - LC/MS
  - HPLC
  - GC with various detectors

### Great variability among laboratories

- Screening and confirmation cutoffs varied by as much as two orders of magnitude
- 28% of laboratories reported analytical services for both blood and urine
- No difference between urine and blood screening and confirmation levels
  * Deemed inappropriate due to drug/metabolite concentrations found in those matrices due to therapeutic use or misuse
- Differences in screening and confirmation cutoffs within the same jurisdiction
  * Not a good public policy – the same sample might test either positive or negative depending on which laboratory it was sent to
- Findings indicated a need for more uniformity amongst laboratories performing testing on DUID casework
Initial Survey Findings
Top 10 most frequently encountered drugs

- Top 5 drugs
  - Cannabis
  - Benzodiazepines & Cocaine
  - Hydrocodone
  - Morphine/Codeine
  - Methamphetamine & Carisoprodol/Meprobamate

- Top 10 most frequently encountered drugs

<table>
<thead>
<tr>
<th>Drug</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannabis</td>
<td>39</td>
</tr>
<tr>
<td>Benzodiazepines*</td>
<td>33</td>
</tr>
<tr>
<td>Cocaine</td>
<td>37</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>30</td>
</tr>
<tr>
<td>Morphine/Codeine</td>
<td>28</td>
</tr>
<tr>
<td>Methamphetamine</td>
<td>26</td>
</tr>
<tr>
<td>Carisoprodol/Meprobamate</td>
<td>20</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>16</td>
</tr>
<tr>
<td>Methadone</td>
<td>12</td>
</tr>
<tr>
<td>Antidepressants*</td>
<td>11</td>
</tr>
<tr>
<td>Zolpidem</td>
<td>10</td>
</tr>
<tr>
<td>Phencyclidine (PCP)</td>
<td>8</td>
</tr>
<tr>
<td>Barbiturates/Barbitalates5</td>
<td>7</td>
</tr>
<tr>
<td>Diphenhydramine</td>
<td>6</td>
</tr>
<tr>
<td>3,4-Methylenedioxyamphetamine</td>
<td>5</td>
</tr>
<tr>
<td>Propoxyphene</td>
<td>5</td>
</tr>
<tr>
<td>Ephedrine/Pseudoephedrine</td>
<td>2</td>
</tr>
<tr>
<td>Cyclobenzaprine</td>
<td>1</td>
</tr>
<tr>
<td>Doxylamine</td>
<td>1</td>
</tr>
<tr>
<td>Gamma-hydroxybutyrate</td>
<td>1</td>
</tr>
<tr>
<td>Retaine</td>
<td>1</td>
</tr>
<tr>
<td>Phenelzine</td>
<td>1</td>
</tr>
<tr>
<td>Tryptophine</td>
<td>1</td>
</tr>
</tbody>
</table>

*Oxycodone = 28, Alprazolam = 27, Oxazepam/Nordiazepam = 7, Clonazepam = 4, Lorazepam = 3, Temazepam = 1, and benzodiazepines with no specific information = 2.

2007 Recommendations

- 44 drugs listed in scope for both blood and urine specimens
  - Not an exhaustive list
  - Acknowledgement of regional variability of drug trends
  - Does not include drugs where immunoassays are not commercially available
    - GHB, hallucinogens, inhalants
  - Cutoffs based on analytical methodology and good laboratory practice rather than pharmacology or the probability of impairment

<table>
<thead>
<tr>
<th>Blood</th>
<th>Urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpreted by comparison with other populations</td>
<td>Easy to collect</td>
</tr>
<tr>
<td>Ratios of parent to metabolite can differentiate acute from recent or chronic use</td>
<td>Can test positive for drugs long after impairing effects have dissipated</td>
</tr>
<tr>
<td>Difficult to collect</td>
<td>No verified correlation between urine drug concentrations and effects</td>
</tr>
</tbody>
</table>
  - Requires a phlebotomist or medical staff |
  - Delay in collection          |
Increasing DUID Prevalence Prompts 2012 Survey

- The issue of drug impaired driving in the U.S. became the focus of top safety organizations who called for standardization which prompted another survey with updated recommendations

<table>
<thead>
<tr>
<th>Organization</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Roadside Survey</td>
<td>Highlighted the high incidence of potentially impairing drug use in the driving population</td>
</tr>
<tr>
<td>National Highway Traffic Safety Administration (NHTSA)</td>
<td>Issued a report proposing guidelines for standardization in evaluating drugs</td>
</tr>
<tr>
<td>National Governors Highway Safety Association (NGHSA)</td>
<td>Called for the evaluation of the feasibility of establishing national standards for controlled substances in drug-impaired driving</td>
</tr>
</tbody>
</table>
| US Office of National Drug Control Policy (ONDCP)   | • Issued national strategy for drug demand reduction including drug-impaired driving  
                                             • Called for the development of standardized screening methodologies for drug testing laboratories  
                                             • Called for implementation of oral fluid testing as a tool to aid in impaired driving performance |
| National Transportation Safety Board (NTSB)        | Called on NHTSA to support the development of standard practices for drug testing in transportation accident investigations |
Increasing DUID Prevalence Prompts 2012 Survey

- Laboratories highlighted prevalence of drug use in driving cases
  - Under-reporting of drugs when alcohol is detected
  - Other drugs present when alcohol tested positive
- **The 2009 National Academy of Sciences (NAS) Report**
  - Called for better standardization of approaches to forensic analysis and consensus-based standards

2012 Survey Findings

- **Questions related to:**
  - Laboratory type
  - Turnaround time and workload data
  - Matrices tested and screening and confirmation procedures
  - Staffing and training
  - Materials needed
  - Compliance with previous iteration of recommendations (scope and sensitivity)
- **Survey via SurveyMonkey® completed by 96 laboratories**
  - State, county, city, private, and academic laboratories
2012 Survey Findings

Top 20 most frequently encountered drugs

- **Top 5 drugs (previous survey)**
  - Cannabis
  - Benzodiazepines & Cocaine
  - Hydrocodone
  - Morphine/Codeine
  - Methamphetamine & Carisoprodol/Meprobamate

### Assessing Compliance with 2007 Recommendations

2012 Survey Findings

- ~30% of laboratories not in compliance (blood) disagreed with some aspect with the recommendation
- ~18% of laboratories not in compliance (urine) disagreed with some aspect with the recommendation

**Reasons for not meeting recommendations (blood and urine):**
- Deficiencies in staffing, appropriate instrument technology, instrument capacity, method validation
- Qualitative analysis only or quantitative analysis in select blood cases
- DUID law in their jurisdiction covers only scheduled substances (hard to justify expenditure of resources on more extensive testing)
## 2013 Recommendations

Established Tier I and Tier II

<table>
<thead>
<tr>
<th>Tier I</th>
<th>Tier II</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Drugs most prevalent in US driving populations</td>
<td>- Drugs less frequently encountered</td>
</tr>
<tr>
<td>- Strongest evidence of impairment</td>
<td>- Regional rather than national significance</td>
</tr>
<tr>
<td>- Detected by the use of commercially available immunoassays</td>
<td>- Beyond routine analytical capabilities of some laboratories</td>
</tr>
<tr>
<td>- Minimum acceptable scope for DUID testing (33 compounds)</td>
<td>- Associated with the potential for impairment</td>
</tr>
<tr>
<td>- Blood, urine, and oral fluid</td>
<td>- Includes synthetic cannabinoids, CNS stimulants and depressants, narcotic analgesics, dissociative drugs, hallucinogens, and inhalants</td>
</tr>
</tbody>
</table>

### 2013 Recommendations

- **Acknowledgement of widespread practice of omitting drug testing if the blood alcohol testing exceeds 0.08g/100mL in blood, or g/210L in breath**
  - Known as "stop-limit" testing
  - Creates blind spot in knowledge of combined drug and alcohol use
- **Laboratories must offer confirmatory testing for all compounds included in screening scope**
  - Only report test results for confirmed compounds
  - Should not report presumptive screening-positive test result
  - Identity another laboratory that can perform confirmatory testing if testing is not available at original laboratory
2013 Recommendations
Matrices

**Blood**
- Preferred specimen
- Concentrations can be evaluated within context (therapeutic, toxic, recreational use)

**Oral Fluid**
- Collection – easy and low cost
- Obtain proximate to the time of driving
- Preliminary on-site test results available for probable cause or evaluation
- Best suited to per se states or impairment noted from observations or sobriety tests
- Positive result can be used to identify recent drug use

**Urine**
- Demonstrates prior drug use or exposure
- No verified correlation between urine drug concentrations and effects
- Can test positive for drugs long after impairing effects have dissipated

2016 Survey / 2017 Recommendations
NHTSA Prompts 2016 Survey

- NHTSA requested another review of the recommendations
  - Changes available in technology since the 2013 recommendations
  - Increased popularity and rapidly changing landscape of novel psychoactive substances (NPS)

2016 Survey Findings

- Survey via SurveyMonkey® completed by 70 laboratories

- Specimens tested:
  - 90% test blood samples
  - 68% test urine
  - 1% test oral fluid
2016 Survey Findings

Screening Methods

- Top three methods
  - Blood
    - 74% ELISA, 50% GC/MS, 39% LC-MS-MS
  - Urine
    - 49% ELISA, 37% GC/MS, 29% LC-MS-MS

Confirmation Methods

- Top three methods
  - Blood
    - 87% GC/MS, 81% LC-MS-MS, 4% LC-TOF
  - Urine
    - 77% GC/MS, 54% LC-MS-MS, 3% LC-TOF

Compliance with 2013 recommendations

- 17% of laboratories met or exceeded all recommendations
- 52% are partially in compliance and actively developing or validating methods to meet remaining recommendations
- 20% do not believe the recommendations for some compounds are relevant for their laboratory (low prevalence)

Trends (2007 and 2013 recommendations)

- Cutoff limits that did not change had about the same or increased compliance
- Cutoff limits that had been lowered showed lower rates of compliance
  - Laboratories needed more time to meet compliance through revalidation
- Reasons for lack of compliance:
  - Lack of staffing, instrument capacity, instrument technology, analyst time for method validation, budget, cutoffs not relevant for their laboratory

Tier II testing

- 81% test for some compounds
2016 Survey Findings
Top 10 most frequently detected drugs

- **Top 5 consistent with initial survey and 2012 survey**
  - Alprazolam/alpha-hydroxyalprazolam
  - THC and metabolites
  - Oxycodone
  - Morphine
  - Methamphetamine & Cocaine/metabolites

Consensus Meeting

- **Subset of survey participants invited to review the results of the 2016 survey and the 2013 recommendations**
  - Selected based on geographic location, agency type, and workload to provide diversity of experience and perspective
  - Provided additional detail on screening and confirmation cutoffs used in their laboratory
  - Used peer-reviewed literature to assist with promotion/demotion of analytes to Tier I and Tier II scope
  - Performed a line-by-line review of the 2013 recommendations using a modified Delphi method
2017 Recommendations

Tier I and Tier II

Promotions

- Buprenorphine and metabolite, fentanyl, tramadol and metabolite – Tier II to Tier I due to increased prevalence and potential for impairment

Demotions

- Butalbital and phenobarbital – Tier I to Tier II due to low prevalence
- Phencyclidine (PCP) – Tier I to Tier II due to low/regional prevalence

Removals from Tier II

- Meperidine and propoxyphene – due to discontinued availability in the U.S.
- Due to low prevalence
  - Modafinil, citalopram, clonidine, doxepin, fluoxetine, olanzapine, paroxetine, phenazepam, quetiapine, risperidone, sertraline, trazodone, triazolam, venlafaxine, zaleplon, LSD, psilocybin

Additions to Tier II

- Increased prevalence and potential for impairment
  - Fentanyl analogs, mitragynine, novel opioids, atypical antipsychotics, novel benzodiazepines
- Tricyclic antidepressants added as a class

Changes to cutoffs

- **Blood**
  - Screening cutoffs for low dose benzodiazepines changed to 10 ng/mL and 50 ng/mL for high dose
  - Cutoff for oxymorphone was eliminated – screening for oxycodone for ELISA
- **Urine**
  - Cutoff established for carboxy-THC and zolpidem – screening using ELISA
  - Cutoff removed for MDMA/MDA – screening for amphetamine/methamphetamine using ELISA
- **Oral fluid**
  - Cutoffs improved based on 1 laboratory’s validated testing

Matrices

- **Urine is best suited to demonstrate historical drug use or exposure**
  - Less reliable specimen in the context of impaired driving
  - Inferior to blood and oral fluid
  - Should be interpreted caution
What prompted this review?
- Drug trends continuing to evolve in impaired driving cases
- Changes available in technology (widespread availability, more sensitivity)
- The American Academy of Forensic Sciences Standards Board (ASB) used the 2017 recommendations as the basis for Standard 120 “Standard for the Analytical Scope and Sensitivity of Forensic Toxicology Blood Testing in Impaired Driving Investigations”
2020 Survey Findings

- Survey via SurveyMonkey® completed by 65 laboratories

- Specimens tested
  - 89% test blood samples
  - 63% test urine
  - 3% test oral fluid

- Top three methods

  - **Blood**
    - 51% ELISA, 35% GC/MS, 31% LC-MS-MS
  - **Urine**
    - 34% GC/MS, 28% ELISA, 23% LC-MS-MS and EMIT

- Top three methods

  - **Blood**
    - 88% LC-MS-MS, 71% GC/MS, 12% LC-HRMS
  - **Urine**
    - 62% GC/MS, 51% LC-MS-MS, 11% LC-HRMS
2020 Survey Findings

- **Compliance with 2017 recommendations**
  - 12% of laboratories met or exceeded all recommendations
  - 40% are partially in compliance and actively developing or validating methods to meet remaining recommendations
  - 19% do not believe the recommendations for some compounds are relevant for their laboratory (low prevalence)
  - 44% were close to meeting the recommendations; however, method validation was not a high management priority

- **Trends (2013 and 2017 recommendations)**
  - Cutoff limits that did not change had about the same or increased compliance
  - Cutoff limits that had been lowered showed lower rates of compliance
  - Laboratories needed more time to meet compliance through revalidation
  - Reasons for lack of compliance:
    - Lack of staffing, instrument capacity, instrument technology, analyst time for method validation, budget, cutoffs not relevant for their laboratory

- **Tier II testing**
  - 91% test for some compounds

### Top 5 mostly consistent with previous surveys
- Most notable: Fentanyl
- 26% of laboratories in 2016 survey
- 70% of laboratories in 2020 survey

### Table 1: Number of Laboratories Reporting This Drug/Drug Class in Their 15 Most Frequently Detected Drugs (n = 64)

<table>
<thead>
<tr>
<th>Compound</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>APAP/THC and metabolites</td>
<td>62</td>
</tr>
<tr>
<td>Amphetamines/MDMA</td>
<td>37</td>
</tr>
<tr>
<td>Cocaine and metabolites</td>
<td>37</td>
</tr>
<tr>
<td>Methamphetamine</td>
<td>26</td>
</tr>
<tr>
<td>Benzodiazepines/antidepressants</td>
<td>23</td>
</tr>
<tr>
<td>Methadone</td>
<td>22</td>
</tr>
<tr>
<td>Codeine</td>
<td>18</td>
</tr>
<tr>
<td>Respiratory/antihistamines</td>
<td>13</td>
</tr>
<tr>
<td>Tramadol/ODAD/Tramadol</td>
<td>12</td>
</tr>
<tr>
<td>Phencyclidine/PCP</td>
<td>11</td>
</tr>
<tr>
<td>Ibuprofen/NSAID</td>
<td>11</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>11</td>
</tr>
<tr>
<td>Tinidazol</td>
<td>9</td>
</tr>
<tr>
<td>Alprazolam</td>
<td>9</td>
</tr>
<tr>
<td>Carbamazepine/disopyramide</td>
<td>8</td>
</tr>
<tr>
<td>Cyclobenzaprine</td>
<td>8</td>
</tr>
<tr>
<td>Dextromethorphan</td>
<td>8</td>
</tr>
</tbody>
</table>

- Hydroxycamphene
- Novel benzodiazepines
- Tranquilizers
- Narcotics
- Antidepressants
- Neurontin
- Antipsychotics
- Antidepressants
- Antipsychotics
- Synthetic cannabinoids
- Valproic acid
- Venlafaxine

*Non-prescribed
*Top 15 compounds
Consensus Meeting

- Subset of survey participants invited to review the results of the 2020 survey and the 2017 recommendations
  - Selected based on geographic location, agency type, workload, and matrices tested to provide diversity of experience and perspective
  - Performed a line-by-line review of the 2017 recommendations using a modified Delphi method

2021 Recommendations

Tier I and Tier II

**Tier I**
- No changes to scope (no promotions/demotions)
- Screening and confirmation cutoffs for carisoprodol raised to 1000 ng/mL
- Screening cutoff for meprobamate removed in blood and urine
- Confirmation cutoff for norbuprenorphine raised to 1 ng/mL in blood
- Confirmation cutoff for fentanyl raised to 1 ng/mL in urine
- Compounds should have cross-reactivity at or above 80% of the target ELISA compound
- Changes to several oral fluid cutoffs

**Tier II**
- Trazodone added due to increased prevalence (previously removed from the 2013 recommendations due to decreased prevalence)
- Difluoroethane (DFE) added due to increased prevalence

**Matrices**
- Urine
  - Demonstrates prior drug use or exposure
  - No verified correlation between urine drug concentrations and effects
  - Last iteration containing urine cutoffs
- Blood and oral fluid are the preferred matrices for testing
**Trends**

**Caseload**
- Increase reported per laboratory for both drug and alcohol cases

**Compliance with Tier I**
- Cutoffs that did not change saw an increase in compliance or remained about the same
- Lack of staffing, training, time, money, and laboratory space provide challenges for compliance

<table>
<thead>
<tr>
<th>Compliance</th>
<th>2013 Recommendations</th>
<th>2017 Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet or exceeded</td>
<td>Blood</td>
<td>Urine</td>
</tr>
<tr>
<td>recommendations</td>
<td>17%</td>
<td>18%</td>
</tr>
<tr>
<td>Did not agree with</td>
<td>Blood</td>
<td>Urine</td>
</tr>
<tr>
<td>some recommendations</td>
<td>20%</td>
<td>32%</td>
</tr>
<tr>
<td>In process of making</td>
<td>Blood</td>
<td>Urine</td>
</tr>
<tr>
<td>changes to meet</td>
<td>52%</td>
<td>36%</td>
</tr>
<tr>
<td>recommendations but</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>not priority</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Instrument Technology**

**Blood Samples**

<table>
<thead>
<tr>
<th>Top 3 Screening Methods</th>
<th>2016</th>
<th>2020</th>
<th>Top 3 Confirming Methods</th>
<th>2016</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELISA - 15%</td>
<td>GC-MS - 35%</td>
<td>LC-MS - 41%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GC-MS - 35%</td>
<td>GC-MS - 35%</td>
<td>LC-MS - 41%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC-MS - 35%</td>
<td>LC-MS - 35%</td>
<td>LC-TOF - 4%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Urine Samples**

<table>
<thead>
<tr>
<th>Top 3 Screening Methods</th>
<th>2016</th>
<th>2020</th>
<th>Top 3 Confirming Methods</th>
<th>2016</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELISA - 15%</td>
<td>GC-MS - 32%</td>
<td>GC-ML - 32%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GC-MS - 32%</td>
<td>GC-MS - 32%</td>
<td>GC-ML - 32%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC-MS - 32%</td>
<td>LC-MS - 32%</td>
<td>LC-MS - 32%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC-TOF - 3%</td>
<td>LC-MS - 32%</td>
<td>LC-MS - 32%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tier II Testing**
- In 2016, 81% of laboratories
- In 2020, 91% of laboratories

**Tier I Scope**
- Top drugs consistently detected year after year
  - All in Tier I or Tier II scope
What Could Happen Next?
My opinions/predictions after involvement with 2 iterations

• **Tier I**
  • 2021 Recommendations – last iteration to include urine as a matrix
  • Continue to enhance oral fluid cutoffs
  • Demotion of carisoprodol and meprobamate to Tier II?
  • Promotion of gabapentin from Tier II?

• **Tier II**
  • Removal of some compounds after reviewing Top 15 most frequently detected drugs?
  • Continue to include NPS as a class
  • Call out specific hallucinogens?

• **Survey is currently open – is your laboratory participating?**
## Tier I Testing

<table>
<thead>
<tr>
<th>Testing</th>
<th>Compliance – Blood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Matrices for testing</strong></td>
<td>• Screening – mostly compliant</td>
</tr>
<tr>
<td>• Blood, urine, oral fluid</td>
<td>• Above the cutoff for some low-dose benzodiazepines</td>
</tr>
<tr>
<td>• Vitreous fluid (confirm findings, ex. 6-MAM and ethanol)</td>
<td>• Ex. clonazepam and 7-aminoclonazepam</td>
</tr>
<tr>
<td><strong>Screening technologies</strong></td>
<td>• Basic panel via ELISA – detected together eliciting a combined positive response so setting each at 10 ng/mL is not a priority at this time</td>
</tr>
<tr>
<td>• Blood – ELISA, LC-HRMS</td>
<td>• Expanded panel via LC-HRMS – able to detect</td>
</tr>
<tr>
<td>• Urine – EMIT, LC-HRMS</td>
<td>• Above the cutoff for morphine</td>
</tr>
<tr>
<td>• Oral fluid – LC-MS</td>
<td>• Confirmation – mostly compliant</td>
</tr>
<tr>
<td><strong>Confirmation technologies</strong></td>
<td>• Above the cutoff for meprobamate</td>
</tr>
<tr>
<td>• Blood – GC-MS, LC-MS</td>
<td></td>
</tr>
<tr>
<td>• Urine – GC-MS, LC-MS</td>
<td></td>
</tr>
<tr>
<td>• Oral fluid – LC-MS</td>
<td></td>
</tr>
</tbody>
</table>
Tier II Testing

- All compounds available for testing at NMS Labs
- Not all within DUID/DRE panel but can be tested for upon request

Drug Positivity

2017-2023

- Top dotted line = any analyte
  - 66-93%, average = 76%
- #1 drug detected = cannabinoids
  - Consistent with top drugs detected on DUID survey
Drug Positivity
2017-2023

- **Other top drugs**
  - Methamphetamine/MDMA, Amphetamines
  - Cocaine/metabolites
  - Benzodiazepines
  - Fentanyl/Acetyl fentanyl

- **Consistent with top drugs detected on DUID survey**

A huge thank you to all of the laboratories that participated in our surveys and consensus meetings over the years!
Thank you!

Any questions, please email me at
Amanda.Dorazio@NMSLabs.com