ABCs of Drug Testing in Child Welfare Cases

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Introduction

• What is drug screening?

• Who performs drug screening tests?

• Are they all alike?

• How do we interpret the results?
Clinical V. Forensic

• Clinical Toxicology is concerned primarily with treating a patient.

• Clinical does not have to be as precise or accurate as Forensic
Clinical V. Forensic

• Drug tests are used to evaluate the medical condition of a patient
  – Clinical Toxicology

• Drug tests are used to determine whether someone uses or is under the influence of drugs
  – Forensic Drug Testing
  – Employers
  – Legal System
Clinical V. Forensic

- Patient consent not required
- Identity of specimen is presumed
- Screening result is usually sufficient for medical decision

- Subject must give consent
- Identity of specimen must be proved (Chain of Custody)
- Results are confirmed
- Results are used for legal action
Fate of Drugs in the Body

A Absorption

D Distribution

M Metabolism

E Elimination
TYPES OF ABUSED DRUGS

• Stimulants
• Hallucinogens
• Depressants
• Inhalants
• Steroids
Testing

What is tested?

• Blood
• Urine
• Hair
• Saliva
• Sweat
• Breath
• Vitreous
• Meconium
Blood

Most invasive

Tests for current conditions

Actively under the influence

Short window for acute exposures
Urine

• Most common
• No correlation to blood levels
• OTC and Laboratory
• Larger window of detection (compared to blood)
• Indicates recent history of usage
Hair

Advantages
  Longest window of detection
  Least Invasive

Disadvantages
  Difficult to do correctly
  Does not indicate recent use
  More Issues
    Environmental
    Hair treatment / hair color
Saliva / Sweat

Saliva
- Less invasive
- May have correlations with blood levels
- Detection time similar to blood

Sweat
- can monitor compliance over several days
Meconium / Vitreous

Meconium
  Less invasive
  Newborn

Vitreous
  Post-mortem
  Limited
Breath

Primarily for alcohol
Methods of Testing

- **Screening** tests indicate the presence or absence of a particular drug or related compounds.

- **Confirmatory** tests must unequivocally identify the compound in question:
  - More sensitive
  - More Specific
Methods of Testing

Screening Tests
  Spot Tests
  Immunoassays
Other Techniques
  Thin Layer Chromatography (TLC)
  Liquid Chromatography (HPLC)
  Gas Chromatography (GC)
DRUG TESTING

• Screening Test
  • Immunoassay
    » EIA
    » RIA
    » FPIA
    » CEDIA
    » KIMS

• Point of Care Testing
  – Instrumented
  – Non-Instrumented
    » Lateral Flow
DRUG TESTING

• Confirmatory Test

Gas Chromatography / Mass Spectrometry

Liquid Chromatography / Mass Spectrometry
Methods of Testing

Mass Spectrometry

- Used to determine Molecular weight

- Molecular Fragments formed by this process are as unique to chemical compounds as fingerprints are to humans
Terminology

- Threshold or “Cut Off“
- Limit of Detection
- Sensitivity
- Specificity
- False Positive
- False Negative
- Cross-Reactivity
**Terminology**

**Cutoff** – The value at or above which a screening test is deemed to be presumptively positive and below which is negative.

**Threshold** – same as cutoff.

**False Positive** – a positive result on a sample that does not contain the target analyte.

**False Negative** – a negative result on a sample that contains the target analyte in a concentration at or above the threshold.
Terminology

Sensitivity- the characteristic of an assay that is determined by the smallest concentration of a substance that can be reliably measured by a given analytical method. The lower the limit of detection, the more sensitive the assay.

Specificity- the characteristic of an assay that is determined by the selective attachment or influence of one substance on another, i.e. an antibody and its specific antigen. The more specific the assay, the fewer the compounds that will cross react to yield a positive result.
Terminology

**Limit of Detection** – the point at which an analyte can reliably distinguish from the background environment. Typically a signal to noise ratio greater than 3.

**Limit of Quantitation** – the lowest amount of analyte in a sample which can be quantitatively determined with suitable precision and accuracy.
Drugs Testing

How Long Can Drugs be Detected in Urine?

- Varies from drug to drug, but most drugs can be detected in urine for up to 72 hours after a single dose

- Marijuana can be detected in urine for two weeks to months*
### Screening thresholds for SAMHSA drugs

<table>
<thead>
<tr>
<th>Drug</th>
<th>ng/mL urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphetamines</td>
<td>1000</td>
</tr>
<tr>
<td>Cocaine (benzoylecgonine)</td>
<td>300</td>
</tr>
<tr>
<td>Opiates (morphine, codeine)</td>
<td>2000</td>
</tr>
<tr>
<td>Phencyclidine</td>
<td>25</td>
</tr>
<tr>
<td>THC</td>
<td>50</td>
</tr>
</tbody>
</table>
Common Panels

• NIDA 5
  – Cocaine, Opiate, THC, Amphetamines, PCP

• 7 panel
  – Typically adds Benzodiazepines, Barbiturates, etc.

• 10 panel
  – Amphetamines, Cocaine metabolite, THC metabolite, Opiates, PCP, Barbiturates, Benzodiazepines, Propoxyphene, Methadone, Methaqualone
False Positives

• Differ with different assays
• Some commonly prescribed therapeutic drugs may yield false positives
  – Ranitidine
  – Verapamil
  – Diphenhydramine
  – Phenylpropanolamine
  – Venlafaxine
  – Ibuprofen
  – Quetiapine
Common Panels v. Abused Drugs

Amphetamines

Screen: 1000 ng/mL  Confirm: 500 ng/mL

• Methamphetamine
Screen: 1000 ng/mL  Confirm: 500 ng/mL plus Amphetamine at > 200 ng/mL

• Ecstasy
  – MDMA and MDA
Common Panels v. Abused Drugs

Amphetamines

• Ritalin

• Bath Salts (Cathinones)

• False Positive
  – Most number of compounds that have been associated with FP
  – amantadine, bupropion, chlorpromazine, desipramine, fluoxetine, L-enantiomers, labetalol, methylphenidate, phentermine, phenylephrine, PPA, promethazine, pseudoephedrine, ranitidine, thioridazine, trazodone
Common Panels v. Abused Drugs

Cocaine

- Metabolite

Screen: 300 ng/mL    Confirm: 150 ng/mL

- False Positives
  - Lay literature reports many things including diabetes, liver or kidney disease, amoxicillin, tonic water

- Passive Exposure
  - Money
  - Sidestream inhalation
  - Boston Police
Common Panels v. Abused Drugs

Opiates

Screen: 2000 ng/mL
Confirm: 2000 ng/mL (Morphine, Codeine) 6-MAM 10 ng/mL

• Metabolite
  – Codeine is metabolized to morphine (less than 20%)
Common Panels v. Abused Drugs

Opiates

• Opioids
• Oxycodone
• Fentanyl
• Dextromethorphan

• False Positives
  – Poppy Seeds
  – Rifampin, Rifampicin, Fluoroquinolones, DM, Diphendhydramine
Common Panels v. Abused Drugs

Phencyclidine

• Regional

• False Positives
  – Dextromethorphan
  – Tramadol
  – Diphenhydramine
  – Alprazolam, Clonazepam, Carvedilol
    • Polly drug use
Common Panels v. Abused Drugs

THC
Screen: 50 ng/mL  Confirm: 15 ng/mL (THC-COOH)

• Metabolites

• Cut off

• “Legal Marijuana”
Common Panels v. Abused Drugs

THC
• SPICE

• False Positives
  – Marinol
  – NSAIDs (ibuprofen, naproxen, sulindac)
  – PPIs (Protonix®)

• Passive Exposure
Common Panels v. Abused Drugs

Propoxyphene
• Outdated

Methaqualone
• Outdated but Methylmethaqualone or other derivatives may be back

Barbiturates
• Outdated but some still in use
Common Panels v. Abused Drugs

Benzodiazepines

- Nordiazepam
- Alprazolam
- Clonazepam
Common Panels v. Abused Drugs

**Alcohol**
- Breath
- Ethyl Glucuronide/Ethyl Sulfate

**GHB**

**Inhalants**
False Negatives

Interference with Antigen:Antibody binding

Interference with Confirmation

Dilution
Validity Testing

Adulterants or Other Mechanisms to Defeat Test

- Adulterants
  - Bleach
  - Nitrites

- Substitution
  - Water
  - “Clean Urine”

- Systemic Flushing
Validity Testing

- Temperature
- pH
- Creatinine
- Specific Gravity
- Spots tests for adulterants
INTERPRETING REPORTS

- Must know the **TYPE** of test
- Cutoffs / Thresholds
- Other cross-reacting substances
- Other interfering substances
- Was there a confirmation?
- Timing
TIMING

• When did exposure occur?

• How long following exposure was sample taken?

• Acute exposure

• Chronic exposure
ITEMS OF EVIDENCE

Item: 1  Sample Type: Urine - labeled

Screen by Fluorescence Polarization Immunoassay (FPIA)

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzodiazepines</td>
<td>Positive</td>
<td>mg/L</td>
<td>0.20</td>
</tr>
<tr>
<td>Cannabinoids</td>
<td>Positive</td>
<td>mg/L</td>
<td>0.10</td>
</tr>
<tr>
<td>Opiates</td>
<td>Positive</td>
<td>mg/L</td>
<td>0.10</td>
</tr>
<tr>
<td>Amphetamine/Methamphetamine</td>
<td>Negative</td>
<td>mg/L</td>
<td>1.00</td>
</tr>
<tr>
<td>Cocaine Metabolite</td>
<td>Negative</td>
<td>mg/L</td>
<td>0.30</td>
</tr>
</tbody>
</table>
### Analysis by Gas Chromatography/Mass Spectrometry (GC/MS)

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: Tylenol®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methadone</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: Dolophine®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Ethylidene-1,5-dimethyl-3,3-diphenylpyrrolidine</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: EDDP, Methadone metabolite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: Lortab®, Vicodin®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: Dilaudid®, Hydrostat IR®, Hydrocodone metabolite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dihydrocodeine</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: DHCplus®, Synalgos-DC®, Hydrocodone metabolite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-carboxy-Tetrahydrocannabinol</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: THC metabolite</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS)

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alprazolam</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: Xanax®</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroxyalprazolam</td>
<td>Positive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synonyms: Alprazolam metabolite</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comprehensive Analysis

A comprehensive analysis was performed on this sample. With the exception of the compound(s) listed, no other drugs or poisons of concern were found.
<table>
<thead>
<tr>
<th>Test Name</th>
<th>Normal</th>
<th>Out of Range</th>
<th>Units</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine Drug Screen (10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amphetamines</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Barbiturates</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Cannabinoids</td>
<td></td>
<td>POS.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cocaine</td>
<td></td>
<td>POS.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methadone</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Methaqualone</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Propoxyphene</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Phencyclidine (PCP)</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
<tr>
<td>Opiates</td>
<td>NEG.</td>
<td></td>
<td></td>
<td>NEG.</td>
</tr>
</tbody>
</table>

**Interpretation:** Cutoff limits in ng/ml
- Cannabinoids: 50
- Barbiturates: 200
- Benzodiazepines: 200
- Cocaine: 300
- Opiates: 300
- Amphetamines: 1000
- Phencyclidine: 25
- Methadone: 300
- Methaqualone: 300
- Propoxyphene: 300
Interpretation – Case 1

• Hx: Minor submit’s to a court-ordered drug screen.

Results: Urine-
  – Neg PCP; Neg Cocaine; Neg TCA; Neg Opiates; Neg Amphetamines; Neg Barbiturate; Neg Benzodiazepines, Neg PCP, Neg Propoxyphene, Neg Methadone, Neg Methaqualone

• Positive THC metabolite
Interpretation

• Did this minor use Marijuana?
Interpretation

• Confirmation
  – THC (Delta-9-tetrahydrocannabinol) 5 ng/mL
  – THCA (Delta-9-tetrahydrocannabinol-9-carboxylic acid) 40 ng/mL

• Now what is the interpretation?
Interpretation

• One week later, the minor submits to a private test. The results are negative.

• Now what is the interpretation?
Interpretation – Case 2

• Hx: Student is suspected to be using drugs
• Drug Screen ordered
• Results: Urine- Neg PCP; Pos Cocaine; Neg TCA; Neg Opiates; Neg Amphetamines; Neg Barbiturate; Neg Benzodiazepines.
• Benzoylecgonine present in urine by GC/MS
Interpretation

• Is this student under the influence of cocaine?
• When was cocaine last used?
• Student claims to have been to a party where someone was smoking crack, but student himself was not using drugs; Is this possible?
• Was the Student smoking crack or snorting cocaine?
Interpretation

• The student had a dental procedure the day before the test; the dentist used a product that contains benzocaine to “numb” the student’s gums prior to the procedure;
  – Would this result be a False Positive?
Interpretation - Case 3

• 43 yo wm enters ED in distress; Hx of manic disorder, Meds: Lithium, Klonopin, Prozac.
• Tox Screen ordered
• Results: Urine- Neg PCP; Pos Cocaine; Neg TCA; Neg Opiates; Neg Amphetamines; Neg Barbiturate; Neg Benzodiazepines.
Interpretation

- Is this patient Non-compliant?
- Is this patient currently under the influence of cocaine?
Interpretation – Case 4

• Hx: Older adult caregiver is accused of molesting teenagers; Suspected to be “drugging” victims with Klonopin®; 13 yo victim is identified.

• Tox Screen ordered

• Results: Urine- Neg PCP; Neg Cocaine; Neg TCA; Neg Opiates; Neg Amphetamines; Neg Barbiturate; Neg Benzodiazepines.
Interpretation

• Was this patient drugged?
CONCLUSION

• Fate of Drugs in the Body (ADME)

• What fluid or tissue was tested?

• What type of test was performed?

• What results were reported?

• Must know the limitations of your test
References


NIDA Public Information Office:  
301-443-1124  
www.nida.nih.gov  
www.drugabuse.gov  
www.clubdrugs.com  
www.samhsa.gov  
www.dea.gov  
National Clearinghouse on Alcohol and Drug Information (NCADI):  
1-800-729-6686  
Drug Abuse Warning Network (DAWN)