Challenges of Monitoring Medication Compliance Using Urine Drug Testing

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Objectives

- Demonstrate a working knowledge of drug screening techniques, including immunoassay and mass spectrometry

- Develop an understanding of factors involved in interpreting drug screening results in a compliance setting
Disclosures

• Employed by MEDTOX Laboratories, Inc.

• MEDTOX, incorporated in 1984, is a comprehensive toxicology specialty laboratory. MEDTOX offers toxicology services for therapeutic drug management, clinical toxicology (including pain management), postmortem toxicology, and occupational toxicology.
Outline

• Screening for drugs in biological samples

• The special circumstances of drug screening for the purpose of monitoring compliance
Screening for Drugs in Biological Samples

- Specimen type is typically urine, but may include whole blood, serum, saliva, sweat, vitreous fluid, various tissues, and hair.
- Screens may include
  - Drugs of Abuse
  - Prescription Medications
  - Over the Counter (OTC) Medications
Screening for Drugs in Biological Samples

- Screening by Immunoassay
  - Principles of Immunoassay
  - Threshold concentrations
  - Cross-Reactivity

- Screening and Confirmation by Chromatographic Techniques
  - Principles of Mass Spectrometry
  - Scope

- Interpretation of Results
  - Detection Periods
  - Quantitative Assessments
  - Metabolic Patterns
Principles of Immunoassay

- Immunoassays utilize antibodies and some sort of detection system to identify and quantitate various substances in a sample.
- Antibodies may be monoclonal or polyclonal and may be directed towards very specific drug molecules or an entire drug class.
- “Lock and Key”
Principles of Immunoassay

- Examples of immunoassays include enzyme-linked immunosorbent assay (ELISA), enzyme immunoassay (EIA), microparticle agglutination immunoassay, radioimmunoassay (RIA)
Available Immunoassays

- Commercial immunoassays are available for the following drug classes:

<table>
<thead>
<tr>
<th>Standard Drugs of Abuse</th>
<th>Prescription Opioids</th>
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</thead>
<tbody>
<tr>
<td>Amphetamines</td>
<td>Opiates</td>
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<tr>
<td>Methamphetamine/MDMA</td>
<td>Oxycodones</td>
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<tr>
<td>Sympathomimetic Amines</td>
<td>Methadone</td>
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<tr>
<td>Barbiturates</td>
<td>EDDP (Methadone Metabolite)</td>
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<tr>
<td>Benzodiazepines</td>
<td>Buprenorphine</td>
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<tr>
<td>Cocaine Metabolite</td>
<td>Fentanyl</td>
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<tr>
<td>Phencyclidine</td>
<td>Propoxyphene</td>
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<tr>
<td>Cannabinoids</td>
<td>Tramadol</td>
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<tr>
<td>Tricyclic Antidepressants</td>
<td>Meperidine</td>
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</tbody>
</table>
Threshold Concentrations

- Most immunoassays are targeted towards urine specimens; threshold concentrations producing a positive result may vary.

- Threshold concentrations used for urine specimens are generally not appropriate for blood, serum, saliva, or sweat specimens.
Threshold Concentrations

- Amphetamines: 300 ng/mL, 1000 ng/mL
- Barbiturates: 200 ng/mL, 300 ng/mL
- Benzodiazepines: 200 ng/mL, 300 ng/mL
- Cocaine metabolite: 150 ng/mL, 300 ng/mL
- Opiates: 100 ng/mL, 300 ng/mL, 2000 ng/mL
- Oxycodone: 100 ng/mL
- Phencyclidine: 25 ng/mL
- THC metabolite: 20 ng/mL, 50 ng/mL, 100 ng/mL
- Methadone: 300 ng/mL
- Propoxyphene: 300 ng/mL
- Tricyclic antidepressants: 300 ng/mL
- Fentanyl: 0.5 ng/mL
- Buprenorphine: 5.0 ng/mL
“Lock and Key”
Cross-Reactivity
“NON” Cross-Reactivity
Cross-Reactivities

- **Amphetamines/Sympathomimetic Amines**
  - Good cross-reactivity to amphetamine or methamphetamine, generally not to both; many assays rely on presence of amphetamine metabolite to detect methamphetamine. Newer assays combine multiple antibodies.
  - Methamphetamine antibody has good cross-reactivity to MDMA
  - Good cross-reactivity to phentermine, variable cross-reactivity to ephedrine/pseudoephedrine, phenylpropanolamine, fenfluramine, other sympathomimetic amines.
  - Bupropion and metabolites may also cross-react.
  - Polyclonal assays are less specific for amphetamine/methamphetamine
Cross-Reactivities

- **Barbiturates**
  - Good cross-reactivity to all of the barbiturates, including thiopental
  - Some cross reactivity with related compounds (phenytoin) for some reagents
Cross-Reactivities

- **Benzodiazepines**
  - Variable cross-reactivities, depending on antibody, typically targeted towards nordiazepam or oxazepam.
  - Lorazepam and clonazepam cross-reactivity can be poor, inadequate for flunitrazepam.
  - Some differences between reactivities with conjugated and unconjugated drug.
  - Oxaprozin (Daypro®) cross-reacts with virtually every commercial antibody.
Cross-Reactivities

- **Cocaine Metabolite**
  - Antibodies directed towards benzoylecgonine; poor cross-reactivity with parent cocaine
  - Do not cross-react appreciably with lidocaine or other “caines”
  - Assays are highly reliable
Cross-Reactivities

- Phencyclidine (PCP)
  - Plagued by cross-reactivities with fairly common drugs (venlafaxine, dextromethorphan, others)
  - Prevalence of drug is very low, so most positives are false positives
Cross-Reactivities

- **Cannabinoids**
  - Highly reliable assay
  - Very few documented cross-reactives
  - Ability to confirm positive screens decreases at screening cutoffs below 50 ng/ml
Cross-Reactivities

- **Tricyclic Antidepressants**
  - Good cross-reactivity to most TCAs, not tetracyclic
  - Cross-react with other anticholinergic drugs—antihistamines, phenothiazines, others
Cross-Reactivities

- **Opiates**
  - Antibodies generally directed toward morphine
  - Good cross-reactivity to codeine, morphine, hydrocodone, hydromorphone
  - Poor cross-reactivity to oxycodone, fentanyl, meperidine, other opioids
Cross-Reactivities

- Oxycodones
  - Antibody directed toward oxycodone
  - Good cross-reactivity to oxymorphone
Cross-Reactivities

• Methadone
  • Antibody is directed at parent methadone
  • Cross-reactivity to metabolite is poor; may result in false negative in patients who are taking low to moderate doses of methadone or who are rapid metabolizers
  • Some cross-reactivity to LAAM, very large amounts of diphenhydramine

• EDDP
  • Antibody is directed at EDDP
Cross-Reactivities

- **Buprenorphine**
  - Good reactivity to buprenorphine, poor for norbuprenorphine
  - Few cross-reactives
Cross-Reactivities

- Fentanyl
  - Good reactivity to fentanyl OR norfentanyl
  - Few cross-reactives
Cross-Reactivities

- **Propoxyphene**
  - Good reactivity to propoxyphene and norpropoxyphene
  - Few cross-reactives
Screening and Confirmation by Chromatographic Techniques

- Chromatography—separation of compounds based on partitioning between a mobile phase and a stationary phase.
Confirmation Testing

- Mass spectrometry
  - Mass spectrometer is a type of detector, may be used singly or in tandem in conjunction with gas chromatography (GC/MS) or high performance liquid chromatography (LC/MS/MS)
Principles of Mass Spectrometry

- Drug molecules are bombarded with an electron stream, breaking them into various charged particles (ions)
- This fragmentation is highly reproducible
- Ions are submitted to mass spectrometry to determine the mass to charge ratio and abundance of each ion in the sample
Ephedrine/Pseudoephedrine

\[
\text{Mass/Charge} \quad \begin{array}{ccc}
58 & 71 & 166 \\
178 & 166 & 178
\end{array}
\]

Abundance

Mass/Charge
Methamphetamine

Abundance vs. Mass/Charge

- Mass/Charge 58
- Mass/Charge 91
- Mass/Charge 150
Phentermine

mass/charge

abundance

mass/charge

Phenylethylamine

NH₂
Total Ion Chromatogram

- Amphetamine
- Phentermine
- Methamphetamine
- Phenylpropanolamine
- d,l-Ephedrine

Abundance vs. Retention Time
Scope of Confirmation Testing

- Important to understand scope of the confirmation test, especially for:
  - Amphetamines
  - Benzodiazepines
  - Opiates
Interpretation of Results

- Pharmacokinetics 101
- Detection periods
- Quantitative assessments
- Metabolic patterns
Pharmacokinetics 101
Pharmacokinetics 101

- Steady State
- Time to steady state is five half-lives
- A urine drug screen cannot provide information about long term compliance
  - A urine drug screen provides a great deal of information about non-compliance
Detection Periods

- Amphetamines 1 – 2 days
- Barbiturates 2 – 10 days
- Benzodiazepines 1 – 6 weeks
- Cocaine metabolite 2 – 4 days
- Phencyclidine 2 – 8 days
- THC (marijuana) metabolite 2 days – 11 wks
- Opiates 1 – 2 days
- Methadone 5 – 10 days
- Propoxyphene 1 – 2 days
Quantitative Assessments

- Quantitative values in urine are highly variable; urine can vary almost 100 fold in water content
- Quantitative values can be corrected to creatinine concentration
- Following serial corrected concentrations may be helpful in determining new use of marijuana
- Determination of “compliance” based on corrected concentrations of opiates is controversial
- Quantitative assessment is useful in determining origin of the compound
THC-COOH/Creatinine

THC Usage Ratio  = THC MTB, ug/gm creat, later specimen

THC MTB, ug/gm creat, earlier specimen

NOTE: Specimens must be collected a minimum of 24 hours apart.

THC Usage Ratio >0.5 as predictor of new marijuana use:

Prediction Accuracy  = 85.4%
False Positives  = 5.6%
False Negatives  = 8.6%

THC Usage Ratio >1.5 as predictor of new marijuana use:

Prediction Accuracy  = 74.2%
False Positives  = 0.1%
False Negatives  = 27.0%

(HUESTIS MA AND CONE EJ, NATIONAL INSTITUTE OF HEALTH)
Metabolic Patterns

- Opiates
  - Codeine $\rightarrow$ morphine
  - Heroin $\rightarrow$ 6-acetylmorphine $\rightarrow$ morphine
  - Hydrocodone $\rightarrow$ hydromorphone
  - Hydrocodone $\rightarrow$ dihydrocodeine
  - Oxycodone $\rightarrow$ oxymorphone
  - Fentanyl $\rightarrow$ norfentanyl
  - Buprenorphine $\rightarrow$ norbuprenorphine

- Morphine $\rightarrow$ hydromorphone (less than 5%)
- Codeine $\rightarrow$ hydrocodone (less than 5%)
Metabolic Patterns

- Benzodiazepines
  - Diazepam $\rightarrow$ desmethyldiazepam $\rightarrow$ oxazepam $\leftrightarrow$ temazepam
  - Alprazolam $\rightarrow$ alpha-hydroxyalprazolam
  - Triazolam $\rightarrow$ alpha-hydroxytriazolam
  - Chlordiazepoxide $\rightarrow$ desmethylchlordiazepoxide $\rightarrow$ demoxepam $\rightarrow$ desmethyldiazepam $\rightarrow$ oxazepam $\leftrightarrow$ temazepam
  - Clonazepam $\rightarrow$ 7-aminoclonazepam
Metabolic Patterns

- Amphetamines/sympathomimetic amines
  - Methamphetamine $\rightarrow$ Amphetamine
  - d,l-ephedrine $\rightarrow$ phenylpropanolamine
  - MDMA $\rightarrow$ MDA
Metabolic Patterns

- Barbiturates
  - Thiopental $\rightarrow$ pentobarbital
  - Mephobarbital $\rightarrow$ phenobarbital
  - Primidone $\rightarrow$ phenobarbital and PEMA
Metabolic Patterns

- Cocaine
  - Cocaine $\rightarrow$ benzoylecgonine and others
  - Cocaine + ethanol $\rightarrow$ cocaethylene
Metabolic Patterns

- THC
  - THC $\rightarrow$ carboxyTHC and others
Metabolic Patterns

- Skeletal Muscle Relaxants
  - Carisoprodol $\rightarrow$ meprobamate
  - Methocarbamol $\rightarrow$ guaifenesin
Metabolic Patterns

- Tricyclic Antidepressants
  - Amitriptyline ➔ nortriptyline
  - Imipramine ➔ desipramine
  - Clomipramine ➔ desmethylclomipramine
  - Doxepin ➔ desmethyldoxepin
Monitoring Compliance—
Chronic Pain Clinics

• The problem—drug abuse and drug diversion
• Many pain clinics require patients who are receiving long term treatment with opiates to sign an “opiate contract”
  • Requires patient to disclose all drug use
  • Stipulates possible termination of patient based on urine drug screen compliance.
Monitoring Compliance—Chronic Pain Clinics

- Challenges in monitoring compliance in chronic pain patients:
  - Drug screens are designed to detect presence of drugs, pain clinics are interested in absence of critical drugs
  - Appropriately sensitive detection limits
  - Appropriate scope of testing
Monitoring Compliance—Chronic Pain Clinics

- Meeting the challenge:
  - Specialized drugs of abuse panels, including all opiates and opioids
  - Comprehensive Screening
- Extras:
  - Comparison to drug regimen
  - Interpretive comments
  - Cumulative reporting
  - Consultation services
MEDTOX Compliance Drug Screen

- Two pronged approach: simultaneous immunoassay and LCMSMS screening allows for definitive confirmation of over 170 drug compounds.

Diagram:
- Accessioning
- Immunoassay
- Sciex Qtrap LCMSMS
- Reporting
Page one revolves around compliance/non-compliance with the patient's prescribed regimen.

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Flag</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>100</td>
<td></td>
<td>mg/dL</td>
<td></td>
</tr>
</tbody>
</table>

Drugs Present and Declared for Prescription Verification

<table>
<thead>
<tr>
<th>Drug</th>
<th>Result</th>
<th>Flag</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tramadol</td>
<td>5663</td>
<td>PRESENT</td>
<td>ng/mL</td>
<td>creat</td>
</tr>
</tbody>
</table>

Drugs Present but Not Declared for Prescription Verification

<table>
<thead>
<tr>
<th>Drug</th>
<th>Result</th>
<th>Flag</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methamphetamine</td>
<td>&gt;15000</td>
<td>UNEXPECTED</td>
<td>ng/mL</td>
<td>creat</td>
</tr>
</tbody>
</table>

Sources of methamphetamine include illicit sources, as a schedule II prescription drug, or as a metabolite of some prescription drugs (1-methamphetamine only).

<table>
<thead>
<tr>
<th>Drug</th>
<th>Result</th>
<th>Flag</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphetamine</td>
<td>5000</td>
<td>UNEXPECTED</td>
<td>ng/mL</td>
<td>creat</td>
</tr>
</tbody>
</table>

Amphetamine is an expected metabolite of methamphetamine. Amphetamine is also available as a schedule II prescription drug.

Drugs Absent but Declared for Prescription Verification

<table>
<thead>
<tr>
<th>Drug</th>
<th>Result</th>
<th>Flag</th>
<th>Units</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alprazolam</td>
<td>Not Detected</td>
<td>UNEXPECTED</td>
<td>ng/mg</td>
<td>creat</td>
</tr>
<tr>
<td>Alpha-hydroxyalprazolam</td>
<td>Not Detected</td>
<td>UNEXPECTED</td>
<td>ng/mg</td>
<td>creat</td>
</tr>
</tbody>
</table>

For further interpretive information, please call our TEXASSure Hotline, 1-866-533-0157.

Reported Medications:

The flagging and interpretation on this report are based on the following reported medications:
- Ruczapta (Tramadol)
- Lyrica (Pregabalin)
- Cymbalta (Duloxetine)
- Xanax (Alprazolam)

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<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTHER OPIODS</td>
<td>NEGATIVE</td>
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<tr>
<td>Meperidine</td>
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<tr>
<td>Meperidine Hydrochloride</td>
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<tr>
<td>Methadone</td>
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<td>Methadone Hydrochloride</td>
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<tr>
<td>Methazoline</td>
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<td>Norbinal</td>
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| Promethazine                            | Not Dete
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<td>09/05/2011</td>
<td>09/05/2011</td>
</tr>
<tr>
<td><strong>Creatinine</strong></td>
<td>mg/dL</td>
<td>1000</td>
<td>200</td>
<td>50</td>
<td>300</td>
<td>100</td>
<td>600</td>
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<tr>
<td><strong>Methamphetamine</strong></td>
<td>ng/mg creat</td>
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<tr>
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<tr>
<td><strong>Alprazolam</strong></td>
<td>ng/mg creat</td>
<td>Not Detected</td>
<td>50</td>
<td>40</td>
<td>100</td>
<td>70</td>
<td>150</td>
</tr>
<tr>
<td><strong>Amitriptyline</strong></td>
<td>ng/mg creat</td>
<td>Not Detected</td>
<td>500</td>
<td>400</td>
<td>700</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td><strong>Carbonyl-Tic</strong></td>
<td>ng/mg creat</td>
<td>50</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
</tr>
<tr>
<td><strong>Morphine</strong></td>
<td>ng/mg creat</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
</tr>
<tr>
<td><strong>Taperact</strong></td>
<td>ng/mg creat</td>
<td>5000</td>
<td>5000</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
<td>Not Detected</td>
</tr>
<tr>
<td><strong>Phenobarbital</strong></td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
</tr>
<tr>
<td><strong>Diazepam</strong></td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
<td>PRESENT</td>
</tr>
</tbody>
</table>
Monitoring Compliance—Chronic Pain Clinics

- Advantages of Comprehensive Screening
  - Determine patients overall compliance and truthfulness
  - Detect doctor shopping
  - Specimen validation
  - Therapeutic guidance
  - Determine cause of “false positives” if using rapid drug testing devices
Monitoring Compliance—Chronic Pain Clinics

- Quantitative Analysis
  - Urine drug concentrations vary widely due to hydration status of patient, dose, timing of drug dose with respect to timing of urine collection
  - Quantitative analysis in urine can be useful for monitoring for new use of marijuana in a known previous user.
  - Quantitative analysis can help determine source drug for benzodiazepines and opiates
  - Quantitative analysis to determine “compliance” is controversial
Monitoring Compliance—Chronic Pain Clinics

- Recommendations
  - Specialized DAU Panel or Comprehensive Screen
  - Urine creatinine determination
  - On-site testing may have some applications; however, a good working knowledge of immunoassay cross-reactivities is required.
Monitoring Compliance—Chronic Pain Clinics

- Recommendations
  - Use Chain of Custody and proper collection techniques
  - Store samples for an adequate period of time
  - Keep monitoring random in nature
  - Obtain patient report of recent drug use at each visit
Monitoring Compliance—Chronic Pain Clinics

- Recommendations
  - Establishment of a close working relationship between the clinic and the laboratory
Case History #1

- 40 year-old male with chronic back pain
- Drug regimen:
  - Neurontin, Elavil, Effexor
- Drug screen results:
  - Gabapentin, nortriptyline and mtb., methamphetamine, amphetamine, propoxyphene metabolite, venlafaxine and mtb.
- Patient hotly contests ever having taken “Darvon”, although he has been very open about use of methamphetamine
Case History #2

- 82-year old female with chronic neuritis
- Drug regimen:
  - MS Contin, Prozac, Tegretol
- Drug screen results:
  - Morphine, fluoxetine and metabolite, carbamazepine, desmethyldiazepam, oxazepam, and temazepam
- Physician is calling regarding the presence of benzodiazepines in the drug screen. Patient denies use, she “is a really nice old lady” and he is inclined to believe her.
Case History #3

• 34 year old male with chronic back pain after an accident at work

• Drug regimen:
  • Methadone, Celexa,

• Drug screen results:
  • Oxycodone, methamphetamine, amphetamine, carisoprodol, meprobamate

• Physician is calling to verify results
Case History #4

• 27-year old female with chronic back pain
• Drug regimen:
  • Oxycontin, Prozac
• Drug screen results:
  • Oxycodone, amitriptyline and mtb, fluoxetine and metabolite
• Physician is questioning the presence of amitriptyline
Case History #5

- 37-year old female with chronic back pain
- Drug regimen:
  - Methadone, Prozac, Neurontin
- Drug screen results:
  - Fluoxetine and metabolite, gabapentin
- Physician is questioning the absence of methadone
# Top Ten Positive Findings

<table>
<thead>
<tr>
<th>Drug</th>
<th>Positive Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaminophen</td>
<td>53.3%</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>29.7%</td>
</tr>
<tr>
<td>Oxymorphone</td>
<td>26.7%</td>
</tr>
<tr>
<td>Dihydrocodeine</td>
<td>26.2%</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>25.8%</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>23.3%</td>
</tr>
<tr>
<td>Diphenhydramine</td>
<td>17.6%</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>15.9%</td>
</tr>
<tr>
<td>Carboxy-THC</td>
<td>15.1%</td>
</tr>
</tbody>
</table>
# Illicits

<table>
<thead>
<tr>
<th>Drug</th>
<th>Positive Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carboxy-THC</td>
<td>15.1%</td>
</tr>
<tr>
<td>Methamphetamine</td>
<td>1.36%</td>
</tr>
<tr>
<td>Cocaine/Benzoylecgonine</td>
<td>2.68%</td>
</tr>
</tbody>
</table>
Opiates/Opioids

- Hydrocodone/ hydromorphone/dihydrocodeine: 28%
- Oxycodone/oxymorphone: 25%
- Methadone and/or mtb: 10%
- Fentanyl/Norfentanyl: 6%
- Buprenorphine: 8%
- Tramadol: 9%
- Morphine: 10%
- Codeine: 2%
- Propoxyphene: 1%
- Topentadol: 1%
- Meperidine: 0%
Other Analgesics

- Acetaminophen: 76%
- Ibuprofen: 9%
- Naproxen: 9%
- Salicylate: 5%
- Ketoprofen: 1%
- Oxaprozin: 0%
Benzodiazepines

- Alprazolam/Alpha-hydroxyalprazolam: 34%
- Desmethyldiazepam/Oxazepam/Temazepam: 32%
- 7-aminoctonazepam: 7%
- Lorazepam: 13%
- Alpha-hydroxytriazolam: 0%
Skeletal Muscle Relaxants

- Cyclobenzaprine: 47%
- Carisoprodol / Meprobamate: 26%
- Methocarbamol: 14%
- Baclofen: 6%
- Methadone: 4%
- Metaxalone: 2%
- Orphenadrine: 1%
- Tizanidine: 4%
Anticonvulsants

- Gabapentin: 49%
- Pregabalin: 25%
- Topiramate: 12%
- Lamotrigine: 7%
- Levetiracetam: 4%
- Carbamazepine: 1%
- Zonisamide: 1%
Stimulants

- Ephedrine and/or Pseudoephedrine: 40%
- Methylphenidate: 15%
- Phenylpropanolamine: 25%
- Phentermine: 15%
- Phenmetrazine: 1%
Sedative/Hypnotics

- Zolpidem: 82%
- Zopiclone/Eszopiclone: 17%
- Zaleplon: 1%
Antidepressants

- Citalopram: 20%
- Trazodone: 15%
- Venlafaxine/Desmethylvenlafaxine: 14%
- Amitriptyline/Nortriptyline: 12%
- Duloxetine: 9%
- Bupropion: 9%
- Sertraline: 8%
- Fluoxetine/Norfluoxetine: 8%
- Doxepin/Desmethyldoxepin: 1%
- Imipramine: 0%
- Mirtazapine: 4%
Antipsychotics

- Ziprasidone (39%)
- Quetiapine (18%)
- Risperidone (6%)
- Aripiprazole (5%)
- Olanzapine (1%)
- Perphenazine (1%)
Barbiturates

- Phenobarbital: 26%
- Butalbital: 74%
Antihistamines

- Diphenhydramine: 63%
- Doxylamine: 16%
- Chlorpheniramine: 10%
- Promethazine: 8%
- Hydroxyzine: 2%
- Brompheniramine: 1%
Conclusions

- A thorough understanding of cross-reactivities for a particular immunoassay is essential in interpreting screen only results.
- An understanding of scope of testing, methodology, and reliability of results is important when making clinical decisions based on drug screen results.
- A close working relationship with the testing laboratory is important.
Questions