Drug Testing Pearls from the Adolescent Substance Abuse Program

Adolescent Substance Abuse Program
Center for Adolescent Substance Abuse Research
Children’s Hospital, Boston

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Supplemental Materials

This module is a part of a curriculum designed to introduce clinicians to adolescent Screening, Brief Intervention and Referral to Treatment (SBIRT), and provide them with tools and knowledge to efficiently and effectively address adolescent substance use in the primary-care setting. The curriculum is intended to build upon the core SBIRT Overview module, and includes:

- SBIRT Overview
- Brief Motivational Interviewing
- Confidentiality
- Parent Guidance
- ADHD and Substance Use Disorders
- Pain and Addiction
- Drug Testing

- Buprenorphine Treatment of Opioid Dependence
- Club Drugs
- Infectious Diseases
- Neurobiology of Alcohol and Marijuana Addiction
- Smoking Cessation
Objectives

- This module will review the following:
- The indications for drug testing
- How drug testing is used as an adjunct to other sources of clinical information (e.g. history, physical exam)
- Proper urine collection procedures
- Interpretation of drug test results
- Potential causes of false negative and false positive tests
- Optimal strategies for sharing positive drug test results with the adolescent and his or her parents
Types of drug tests

- Hair can be tested to identify substance use up to 3 months prior. Results are significantly influenced by hair type, with darker and coarser hair more likely to yield positive results.
- Blood, saliva, breath and sweat are the best biological matrices for identifying acute intoxication and such tests are typically used in the emergency room setting.
Urine Drug Testing

• Best biological matrix for detecting previous intoxication.
• Well-studied, standardized, relatively non-invasive.
• Drug concentrations relatively high in the urine.
• Relatively long window of excretion after acute intoxication; varies by substance.
Indications for Drug Testing

- Drug testing can be a useful adjunct in the evaluation of an adolescent with suspected substance use or a substance use disorder.
- Prior to considering drug testing, it is essential to perform a history and physical exam of the adolescent, and obtain a collateral history from the adolescent’s parents.
Taking the History from an Adolescent With Suspected Substance Use

• Key points to look for:
  – New problems with grades or school
  – Skipping school
  – Changes in mood
  – Lack of interest in previous activities (e.g. sports, hobbies)
  – Changes in friends
  – Changes in sleep and awake cycles
  – Increased hostility

• Also important to get information regarding all medications that the adolescent is taking – prescribed and over-the-counter.

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Physical Exam Findings Suggestive of a Substance Use Disorder

- Weight loss
- Decreased attention to personal hygiene
- Injury to the nasal epithelium (from insufflation)
- Injection sites on upper or lower extremities

The physical exam will be normal in the majority of adolescents even with serious substance use disorders.
Clinical indications for Drug Testing

Drug testing should be considered when the history and/or the physical suggests recent drug use, but the adolescent denies substance use.
Case #1:
“Where there’s smoke, there’s fire”
Billy

- 15-year-old boy
- You have previously diagnosed him with “problem use” of marijuana
- He committed to abstinence and had done well for the past three months, according to self-report and collateral report from his parents.
Billy

• Following a school semi-formal, Billy came home with red eyes and smelling of marijuana.
• He denies use.
• The following morning, the parents call you to request a drug test.

A parent concerned about drug use may request a drug test. A test may be useful if parents have reasonable suspicion and the adolescent denies use.
### When is drug testing indicated as part of an assessment?

<table>
<thead>
<tr>
<th>More useful</th>
<th>Less useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific symptoms of intoxication noted (red eyes, alcohol on breath, nodding off)</td>
<td>Vague concerns, “runs in the family”</td>
</tr>
<tr>
<td>Positive history of drug use</td>
<td>“Fishing expedition” -- “I really think he used something”</td>
</tr>
<tr>
<td>Specific substance in question (marijuana, cocaine, etc.)</td>
<td>Substance not easily detectable (e.g. inhalants, salvia)</td>
</tr>
<tr>
<td>Recent time frame (within 72 hours)</td>
<td>Long time frame (more than 72 hours)</td>
</tr>
</tbody>
</table>
Billy

- Denies marijuana use
- Agrees to drug test
- Results:
  - Drugs of abuse screen: positive for cannabis
  - Random urine creatinine 150 mg/dL; Specific Gravity = 1.017
  - GC/MS confirmation positive
Billy and his parents return for a follow-up visit. You meet with Billy alone. He tells you that he did not smoke marijuana, and the positive test must have resulted from “second-hand smoke”.
Urine testing panels

Immunoassays

- Quick, inexpensive
- Screen for multiple drugs at the same time
- Pre-determined “cut-off” value
  - Marijuana cut-off = 50 ng/mL
- Good sensitivity
- High rate of false positives

Note the 50 ng/mL cut-off for an immunoassay. This level would be very difficult to achieve through second-hand exposure. The next slides explain sensitivity and specificity of different types of drug tests.
Screening tests

• Screening tests should have **high sensitivity**.
• Recall that the higher the sensitivity of a test, the lower the rate of **false negatives**.
• Negative result for screening test can subsequently be reassuring to “rule out the disease”, i.e. positive drug test.
• The cutoff level for an initial screening test is generally set to identify **95-98 percent** of true negative results, and **100 percent** of true positive results.

Confirmatory tests

- Confirmatory test should have high specificity.
- Recall that the higher the specificity of a test, the lower the rate of false positives.
- Positive result for confirmatory tests should have a high probability of “presence of disease”, i.e. true positive drug test.
- The cutoff concentrations for the confirmatory test are generally set to ensure that more than 95 percent of specimens with screened positive results are confirmed as true positives.
Confirmatory testing

Gas chromatography/Mass spectrometry

- Gold standard in drug testing
- Highly specific
- Can give quantitative levels
- More expensive than screening
“Hot-boxing”

Some teens intentionally expose themselves to highly concentrated second-hand smoke in order to “get high without smoking”, a practice known as “hot boxing”.

This should be considered marijuana use and treated the same as smoking.
Case #2: “Big gulp”
Alex

• 16 year old boy
• Caught with marijuana and expelled from school
• Denies marijuana use
• Agreed to a urine drug test

Results:
• Drugs of abuse screen: negative
• Random urine creatinine 6 mg/dL;
• Specific gravity = 1.001

Before finalizing the interpretation of this test, consider possible sources of false negative tests.
Interpretation of urine drug test results

Common sources of false negative drug tests:

• Intentional *dilution* of urine sample
• *Adulteration* of urine sample
• *Substitution* of a different urine sample
• Use of substance *not detected* by the drug test panel
• Substance used, but *outside of the time frame* detectable by the test

False negatives tests

Dilute Tests

- One of the most common methods for attempting to defeat a urine drug test
- Patient consumes a large amount of fluids in order to dilute the specimen and drive down drug concentrations below the screening threshold.
- Important to check “random urine creatinine” and specific gravity of each sample.
False negatives tests

Dilute Tests

Random urine creatinine 25-50 mg/dL
Specific gravity < 1.010
  - Moderately dilute; repeat test.
  - Instruct patient to limit water intake to less than 8 ounces in the 2 hours preceding the test.

Random urine creatinine 5-25 mg/dL
Specific gravity < 1.005
  - Very dilute.
  - Automatically considered a positive test.

Random urine creatinine <2 mg/dL
  - Not consistent with human urine.
  - A liquid other than urine is substituted for the urine sample.
  - Automatically considered a positive test.
False negatives tests

Dilute Tests

- Large fluid volume
- Diuretics
- Ingestion of Creatine to artificially raise creatinine
- Ingestion of vitamin B to increase urinary pigment
The following is a list of common urine adulterants which can be covertly added to a urine drug test sample.

- Household products: bleach, salt, Visine, soap
- Glutaraldehyde
- Potassium nitrate
- Pyridinium chlorochromate
- Hydrogen peroxide

These substances typically interfere with immunoassay enzyme screens, causing them to malfunction.

The result is a false negative test.

False negatives tests

A number of products have been designed to defeat drug tests, either by adulteration or substitution, and are readily available to adolescents via the Internet.
Urine collection procedures

- Proper urine collection techniques reduce opportunities for dilution, adulteration, and substitution:
- Experts recommend either direct observation or the “Department of Transportation” protocol, which is described on the next slide.
Department of Transportation protocol

• Before voiding, patient is required to show picture identification, empty pockets and wash hands.
• Patient voids in a room with no running water, and the toilet water is dyed blue.
• Immediately after voiding, patient hands urine specimen to lab personnel who checks the temperature of the specimen.
• Commercial labs may offer this protocol, but generally require a specific order.
Case #3:
Whose urine is this?
• 17 year old girl
• Parents bring Rachel in for an evaluation because they are extremely worried about her, and suspect that she is using drugs.

Parents report:
• Recent weight loss
• New set of friends, whom they have never met
• Extreme moodiness
• Recent episodes of cash and jewelry disappearing from the home. Parents also note that younger sibling’s iPod and video game are missing.
• You meet with Rachel privately, and she denies any use.
• Physical exam is notable for constricted pupils and recent weight loss, otherwise unremarkable.
• You suggest a drug test, and Rachel agrees.

Result:
  - Drugs of abuse screen negative.
  - Random urine creatinine 187 mg/dL, specific gravity 1.015

• You call Rachel’s parents to tell them the drug test came back negative with a plan to refer her for a mental health evaluation. Her mother tells you that she found a water bottle with urine in it in Rachel’s closet.
False negatives tests
Substituted Tests

... a one of a kind, state of the art, electronic urine testing device that will maintain testing temperature for a minimum of 4 hours with one set of batteries.

An adolescent may substitute a sample in order to defeat a test. A number of ingenious devices have been developed to help adolescents substitute urine samples even under direct observation.
Case #4:
“How did that get in there”
Justine

- 17 year old girl
- Caught with marijuana, admitted use
- School requests “medical clearance”
- Agrees to drug test, says it will be positive for marijuana

Results:

- Drugs of abuse screen: positive for cannabis and cocaine
- Urine Creatinine (random) = 62 mg/dL, SG = 1.011
- Confirmatory tests positive for cannabis and cocaine
- Quantitative cannabis level = 87 ng/mL
• Denies “intentional” cocaine use
• Speculates that cocaine may have been mixed in with cannabis
Cocaine

- Cocaine: stimulant made from an alkaloid contained in the leaves of the coca bush, *Erythroxylon coca*. Powdered form has a high melting point and can’t be smoked.
- “Freebase”: hydrochloride group is lysed to lower the melting point while maintaining potency. (Highly flammable and explosive)
- Crack: form of freebase made by hydrochloride extraction with baking soda, heat, and water.

It is not possible to smoke powdered cocaine, though “freebase” (which is rare) and “crack” cocaine can be mixed with marijuana and smoked.
Case #5:
“Cough syrup”
Angela

- 17 year old girl
- Non-specific signs of drug use
- Mother found a bag of marijuana in her coat
- Denies drug use
- Agrees to drug test

Results:
- Drugs of abuse screen: positive for cannabis and opiates
- Urine creatinine (random): 170 mg/dL; SG = 1.010
- GC/MS confirmation positive for cannabis and opiates
Angela

- Says she smoked marijuana once, three weeks ago
- Says she took cough syrup for “allergies” the day before the test
- Could this explain the observed test results?
Marijuana

- Generally cleared in 3-5 days in “occasional users”
- Lipid soluble and may be stored in adipose tissues in heavy, chronic users
  - Prolonged excretion may be up to 6 weeks in these cases

Note that while marijuana can be excreted up to 6 weeks, Angela’s history is not consistent with prolonged excretion. Either she has a more chronic, heavy history of marijuana use or she has used more recently than she is reporting.
**Opiates and Opioids**

- **Opiate**=naturally existing; **Opioid**=synthetic
- Opiate screen detects morphine and codeine
- **Heroin** is metabolized to morphine and codeine, and will give a positive screen
- **OxyContin, Percocet, Vicodin** will all give negative screens. If use of these drugs is suspected order special panel

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**Dextromethorphan** (cough syrup) is NOT an opioid and will not cross-react with the opiate panel (it can cross-react with the PCP panel when present in high concentrations)
Case #6

“It’s my right not to refuse a drug test”
## False positives

### Common cross-reactors

<table>
<thead>
<tr>
<th>Substance</th>
<th>Cross-reactors</th>
</tr>
</thead>
</table>
| Marijuana | • NSAIDs (Ibuprofen, Ketoprofen, Naproxen)  
• Vitamin B supplements  
• Promethazine |
| Amphetamine | • Cold medications (ephedrine)  
• Diet aids (Phenylephrine)  
• Asthma medications  
• Afrin, Primatine |
| PCP | Dextromethorphan |
| Opiates | Fluroquinilone antibiotics |

**Confirmatory test will be negative**


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False positives

Food products or appropriate use of medications can result in a positive drug test result even in the context of a patient who is not abusing drugs.

In these cases, the confirmatory drug test will also be positive. Drug testing cannot distinguish between appropriate use and misuse of medications.
Clinical false positives**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marijuana</td>
<td>Prescription Marinol use (uncommon in teens)</td>
</tr>
<tr>
<td>Cocaine</td>
<td>De-cocanized teas, used common in South America</td>
</tr>
<tr>
<td>Amphetamine</td>
<td>Prescription use of amphetamines (i.e. for ADHD)</td>
</tr>
<tr>
<td>Opiates</td>
<td>• Poppy seeds (in large quantities)</td>
</tr>
<tr>
<td></td>
<td>• Prescription use of opiates for pain.</td>
</tr>
</tbody>
</table>

**Confirmatory test will be positive

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Adam

• 16 year old boy
• School has contacted his parents numerous times because of recent dramatic decline in grades, disrespectful attitude and frequent unexplained absences.
• Parents bring him in for an evaluation, at the school’s suggestion.
You meet with Adam privately.

He tells you that he smokes marijuana with friends sporadically, and drinks alcohol “once in a while” at parties.

He denies use of any other substance.

He seems annoyed by your questions, stating repeatedly that his parents and school personnel are “overreacting.”

Adam
Next, you meet with Adam’s parents.
Based on numerous “red flags” in their history, you recommend a drug test.
Adam refuses.
What to do when a patient refuses to drug test

• The explicit policy of the American Academy of Pediatrics is that physicians should not order a drug test without the adolescent patient’s knowledge or consent.
• If a patient refuses an indicated drug test, parents should set limits using logical consequences.
• An example would be restriction of driving or other activities until the adolescent agrees to a drug test, and parents could ascertain the safety of these activities.
Adam’s parents express their concerns about driving and safety to Adam. They revoke Adam’s driving privileges until he agrees to weekly randomized drug tests. After a week without a car, Adam reluctantly agrees to begin testing.
Adam

Result:

• Adam’s first test shows drugs of abuse screen near cut-off as positive for marijuana, and Adam denies drinking alcohol or using marijuana since getting “caught.” His parents let him continue driving.

• Adam’s next test screens positive for marijuana and morphine.
Even a teen with a serious substance use disorder may be able to remain abstinent for a short period of time, and long enough to produce a negative drug test. Random, serial drug testing will detect most serious substance use disorders. The table on the right shows typical windows of detection for common substances of abuse.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Detection Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocaine &amp; metabolite</td>
<td>6 hours – 3 days</td>
</tr>
<tr>
<td>Barbiturates</td>
<td>1-3 days</td>
</tr>
<tr>
<td>Opiates</td>
<td>1-3 days</td>
</tr>
<tr>
<td>Amphetamines</td>
<td>2-3 days</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>1-7 days</td>
</tr>
<tr>
<td>Methadone</td>
<td>7-9 days</td>
</tr>
<tr>
<td>PCP</td>
<td>8 days</td>
</tr>
<tr>
<td>THC</td>
<td>3-30 days</td>
</tr>
</tbody>
</table>


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• Peter is a 16 year old boy who is very active on his high school lacrosse team.

• His parents privately express their concern to you about Peter’s well-being. On many recent occasions, he has returned home late from playing lacrosse with friends behaving strangely, appearing “stoned,” and spending most of the evening in his room.

• Peter’s parents are worried that he may be using drugs, or that his activity in sports may be causing a mental or physical problem. They ask you to speak with Peter, since he has denied any drug use or health issues to them in earlier conversations.
• You relay the parents’ concerns to Peter during his visit and ask him about his substance use and any health issues related to sports.

• Peter tells you that he had tried marijuana a couple of times in the past. He doesn’t use marijuana now because his lacrosse coach kicked players off the team after suspecting drug use and asking for voluntary drug tests.

• Peter tells you that he might look “off” after practice because he pushes himself really hard and comes home very tired.
You ask Peter whether he would agree to a drug test, and he does.

Results:
- Drugs of abuse screen: negative
- Urine creatinine (random): 263 mg/dL; SG=1.027

A week following his negative drug test, Peter is suspended from school after his coach finds a packet of “K2” on the floor of Peter’s locker.
Many of the drugs commonly used by teens are not reliably detected by immunoassay screens. Examples include inhalants, oxycodone and other narcotics, Ecstasy, dextromethorphan, and synthetic cannabinoids (K2, Spice).

It is critical to know what the testing panel includes when ordering a drug test. Deciding which substance to test for should be based on the suspected substance being used, the substances of abuse in the patient population, and substances used locally (http://www.samhsa.gov/data/DAWN.aspx).

Most substances can be detected in a urine sample, but an appropriate assay must be specifically ordered. Inhalants are not excreted in urine and cannot be detected with urinalysis.
When a drug test is positive...

- Interview the patient privately to determine if another factor (new prescription medication, recent ED visit, etc) could explain the lab findings.
- Inform teen of an unexpected test result without giving details: "There was a problem with your drug test."

At times teens will disclose use of substances not identified on the test. Asking an open-ended question also gives less opportunity for a teen to “craft” an explanation.

- Interpret results based in the context of the teen’s history and self-report.
About the SBIRT Project

When a drug test is positive...

Present information to parents:

- Discuss with the patient exactly what information will be shared
- Obtain written consent if applicable (per 42 CFR Part 2)
- Decide who will present the information
- If the patient requests to speak to the parent privately, confirm the information once they are done
- Keep the report simple and brief: “Billy had a dilute drug test. He told me he used marijuana and took some pills last week.”
When a drug test is positive...
Be the adolescent’s advocate

- Keep the parents focused on the future
- Redirect if they ask “who, what, where, when” questions which tend to “shut down” communication
- Discuss the plan for moving forward. “What’s most important now is how we will move forward. Billy is committed to not using drugs. He has agreed to continue random urine testing and see a counselor to support him in not using drugs again; we will all sign a contract to this effect...”
Summary

- Urine drug testing is a complex procedure!
- Use proper collection procedures
- Check for dilution
- Confirm all positive tests
- Use extended panels if indicated by history
- Use caution in interpreting tests
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