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Drug Retention Times

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Table of contents

| | |
|-------------------|---|
| Introduction..... | 1 |
| Drugs | 1 |
| Findings | 5 |
| Conclusions..... | 5 |
| References | 6 |

Introduction

The purpose of this monograph is to provide information on drug retention times in the human body. The information provided is based on plausible illegal drug use activities that might be engaged in by a recreational drug user.

Based on anecdotal evidence, most people “party” during extended time away from the work environment. Therefore, the following scenarios were envisioned: (1) a person uses an illicit drug at a party on Saturday night (infrequent user); (2) a person uses a drug one time on Friday night and once again on Saturday night (infrequent user); and (3) a person uses a drug on Friday night, uses a drug twice on Saturday night, and once again on Sunday (frequent user).

Drugs

The categories of drugs considered, collectively known as the SAMHSA 5,^{*} are:

- marijuana (and metabolites)
- cocaine (and metabolite)
- opiates (and metabolites)
 - heroin (and metabolites)
 - morphine (and metabolites)
 - codeine (and metabolites)
- amphetamines
 - amphetamine
 - methamphetamine
- phencyclidine (PCP) (and metabolite)

Table 1 identifies the drugs in the SAMHSA 5 including the total number of metabolites and the major metabolite(s) corresponding to each drug type. A drug’s metabolite is the compound produced when the body processes a particular drug. Identifying these compounds is the focus of workplace drug testing analysis. Marijuana possesses the greatest total number of detectable metabolites at 31 but fewer major components. For amphetamines, no metabolites are identified because these substances normally pass through the body essentially unchanged in chemical structure.

^{*} The name is taken from the five categories of drugs included in the U. S. Department of Health and Human Services (HHS) guidance on drug testing in the workplace, Substance Abuse and Mental Health Services Administration (SAMHSA).

| Table 1. Drugs and major metabolites | | |
|---|-------------------------------------|---|
| Drug (SAMHSA 5) | Total number of metabolites* | Major metabolite(s)^{1, **} |
| Marijuana metabolites | 31 | 11-Nor-delta-9-tetrahydrocannabinol (THC) 9 carboxylic acid 11-Hydroxy-delta-9-tetrahydrocannabinol 11-Nor-delta-8-tetrahydrocannabinol (THC) 9 carboxylic acid |
| Cocaine metabolite | 4 | Benzoyllecgonine |
| Opiates/metabolites: Heroin metabolites Morphine metabolites Codeine metabolites | 3 | 6-Acetylmorphine or 6-Monoacetylmorphine Morphine-3-beta-d-glucuronide Morphine-6-glucuronide Codeine-6-glucuronide Morphine-3-glucuronide Morphine-6-glucuronide |
| Amphetamines: Amphetamine Methamphetamine | | Unchanged amphetamine Unchanged methamphetamine |
| Phencyclidine (PCP) | 1 | Hydroxylated PCP |

Note: Throughout the text, superscripts designate references; symbols refer to website links.

* <http://www.passitkit.com/testing1.htm> (7/13/06)

** http://www.keystosaferschools.com/drug_testing_specifics.htm (7/13/06)

Table 2 presents information on detection cutoff levels for the five classes of drugs, both initial and confirmatory levels, which are established by the U.S. Department of Health and Human Services (HHS). The drug cutoff level is the lowest concentration (least amount per unit volume) of a particular drug or its resulting metabolite(s) remaining in the body that will cause a person to be identified as using that substance in a workplace drug test. The initial test refers to the screening assay on specimens to eliminate a “negative” result from the need for further analysis.

| Drug (SAMHSA 5) | Route of administration | HHS detection cutoff level (ng/ml)* |
|--|---------------------------------|--|
| Marijuana/metabolites | oral, smoked | 50 (initial) 15 (confirm) |
| Cocaine/metabolites | injected, smoked, snorted | 150 (initial) 100 (confirm) |
| Opiates/metabolites: Heroin/metabolites | injected, smoked, snorted | 2000 (initial) 10 (confirm) |
| Morphine/metabolites | injected, oral, smoked, snorted | 2000 (initial) 2000 (confirm) |
| Codeine/metabolites | injected, oral | 2000 (initial) 2000 (confirm) |
| Amphetamines: Amphetamine | injected, oral, smoked, snorted | 500 (initial) 250 (confirm) |
| Methamphetamine | injected, oral, smoked, snorted | 500 (initial) 250 (confirm) |
| Phencyclidine (PCP) | injected, oral, smoked, snorted | 25 (initial) 25 (confirm) |

*Cutoff levels are expressed in ng/ml, nanogram per milliliter.

Any “positive” screening test result dictates a specimen being subjected to additional analysis using a gas chromatograph/mass spectrometry system. Confirmatory detection cutoff levels are more stringent than the initial screening levels (Table 2). Specimen analysis is done in certified laboratories that meet the protocol guidelines and analytical methods and standards published by HHS.

An extensive search was conducted of the published literature related to drug retention times in the human body and detection requirements. Major data sources included HHS, SAMHSA, and the National Institute on Drug Abuse (NIDA). However, data containing the level of detail required for analysis of the three study scenarios was not available. Even though detailed data were not available, sufficient information was found that allowed an analysis that considered “infrequent” or occasional drug use versus “frequent” drug use for the SAMHSA 5.

Table 3 provides the detection time periods for the five drugs and their metabolites. Additional information is provided on drug detection times, based on whether the individual

is a frequent or infrequent user. Each detection period is given in a range of days based on the best information available from the literature review.

| Drug (SAMHSA 5) | Infrequent Use Detection period (days) (Scenarios 1 and 2) | Frequent use Detection period (days) (Scenario 3) |
|----------------------------|---|--|
| Marijuana/metabolites | 1 – 5 | 1 – 35 ^{3,4,5} |
| Cocaine/metabolites | 1 – 2 | 1 – 4 |
| Opiates/metabolites: | | |
| Heroin/metabolites | 1 | 1 – 2 |
| Morphine/metabolites | 1 – 2 | 1 – 4 |
| Codeine/metabolites | 1 – 2 | 1 – 2 |
| Amphetamines | | |
| Amphetamine | 1 – 2 | 2 – 4 |
| Methamphetamine | 1 – 2 | 2 – 4 |
| Phencyclidine (PCP) | 2 – 8 | 7 – 14 |

Three weekend drug use scenarios were envisioned: (1) a person uses an illicit drug at a party on Saturday night (infrequent user); (2) a person uses a drug one time on Friday night and once again on Saturday night (infrequent user); and (3) a person uses a drug on Friday night, uses a drug twice on Saturday night, and once again on Sunday (frequent user). With respect to the three scenarios outlined, a person using an illegal drug once or twice over a weekend was considered an infrequent user, whereas the person using an illegal substance more than that over a weekend was considered to be a frequent user. Table 3 presents effective time periods for detecting the SAMHSA 5 drugs by testing infrequent/occasional users and frequent users. The worker using drugs more than twice during a weekend could be tested at the far end of the infrequent detection time periods or at the near end of the frequent testing time intervals in Table 3. Users referred to in the literature as chronic, non-recreational users of these substances would form the bulk of those in our frequent user category. These individuals could be tested with confidence at time intervals toward the far end of the frequent use time periods.

Table 3 presents two testing time periods: one for Scenarios 1 and 2 (infrequent use) and the other for Scenario 3 (frequent use) of the SAMHSA 5. Testing for marijuana can be conducted within five days of infrequent use. For frequent use, review of the literature^{3,4,5} indicates that testing for marijuana can be done within eight days, eight days being the half-life of major marijuana metabolites, and could extend out to as many as 35 days for frequent or chronic use. For cocaine and metabolites, the time interval is one to two days for

Scenarios 1 and 2; for Scenario 3, it is one to four days. For heroin, the major street opiate, testing should be done within one day after infrequent use as in Scenarios 1 and 2 and one to two days after frequent use in Scenario 3. Heroin and its metabolites are typically not retained in the body more than one day for those who can limit their use. Testing for morphine requires one to two days for Scenarios 1 and 2 and one to four days for Scenario 3. In the case of codeine, the detection period is one or two days for all scenarios. Since the window for testing is one to two days for infrequent use of opiates, testing more frequently will increase the potential for detecting opiates. Amphetamines, including amphetamine and methamphetamine, would both require drug testing to be done within time intervals of one to two days for Scenarios 1 and 2 and two to four days for Scenario 3. Phencyclidine detection periods are two to eight days for Scenarios 1 and 2 and seven to 14 days for Scenario 3.

Findings

The effective detection periods show that a “Saturday night only” user (Scenario 1) would likely be identified in a drug test conducted the following Monday, with the possible exception of heroin and its metabolites. Effective detection of marijuana and phencyclidine could be accomplished during a longer detection period. A Friday and Saturday night user (Scenario 2) could be identifiable the following Monday at the latest except for heroin and its metabolites. If a drug test were conducted later, for example, on Wednesday or Thursday of the week following Friday and Saturday use, marijuana or phencyclidine are the only drugs that would likely be detected. It is possible that even regular users of marijuana may not be identified during routine testing after Thursday of a given week following use the previous weekend. In the case of using a drug four times over the weekend (Scenario 3), all drug types would be detectable through the following Thursday except heroin and codeine, which would require testing by Monday and Tuesday, respectively. Due to longer retention times, the drugs (and metabolites) that would likely be detected for frequent users are marijuana and phencyclidine. Marijuana and phencyclidine could be detected for longer periods of time from eight days for phencyclidine to several weeks for marijuana as shown in Table 3.

Conclusions

The following general conclusions can be drawn from the findings in this report:

- In general, to identify recreational (infrequent) users, conduct drug testing early in the work cycle, occasionally testing later in the work cycle to minimize predictability of the random tests. This assumes drug use only during the weekend time period. Use of drugs during the week would shift the detection time frame.

- Because of the short detection period, it would be difficult to identify recreational opiate use by random testing protocols if the individual is capable of avoiding the strong addictive tendency and use it infrequently during non-working periods of at least two days. Although codeine is somewhat less addictive than heroin, the same would apply to this substance.

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