



FORENSIC HAIR DRUG TESTING: A Scientific Introduction

This introduction discusses the basic underlying principles of testing methods for drugs in hair. A brief comparison of currently available tests for drugs of abuse in blood, urine and hair is provided, to give context to the specific features of hair testing.

Testing for drugs of abuse and their metabolites (the body's breakdown products of drugs) may be accomplished in virtually any body fluid or tissue. The analytical methods used are typically similar, regardless of the matrix (tissue or fluid) involved. However, identification of drugs and/or metabolites in the various fluids and tissues may lead to enhanced *interpretations* depending on the matrix.

When drugs or metabolites are identified and quantitated in blood, it is sometimes possible to extrapolate from the time the sample was collected back to the time of an accident or other incident, to theorize about the concentration of the drug in the blood at the time of the incident. From this extrapolation, it is sometimes possible to form an opinion as to the degree of impairment an individual may have been suffering at the time of the incident. However, this "impairment record" is short-lived, with typical clearance of most drugs and metabolites from the blood within eight to twenty-four hours of the last ingestion.

Analyzing urine for drugs and metabolites typically provides a longer time period during which these traces may be detected after the last ingestion or use. This time period of detectability may be as short as 12 hours (for LSD, for example) or as long as 30 days (for a chronic marijuana user), but in general traces of most drugs are detectable only within 3 to 5 days of the last use. Positive findings in urine cannot be used to extrapolate back to the time of ingestion to judge impairment. For this reason, analyses for drugs in urine are typically used to answer the question "Did the subject use a drug within the recent past?"

Hair serves as a repository for drugs, metabolites, vitamins, heavy metals and other substances delivered by the blood to the hair. These substances are principally deposited in the internal portion of the hair, known as the cortex. The keratinized cortex comprises the bulk of the hair mass. The outside covering of the hair, known as the cuticle, generally protects the cortex and helps make the hair an extremely tough and durable natural fiber.

Unlike blood and urine, hair represents a more lengthy record of drug exposure. The average rate of growth for head hair is about 1-centimeter (about 0.4-inches) per month, so a 4-inch length of hair represents a "snapshot" of the subject's drug use in the last 10-months. It is important to note that, due to the relatively slow growth of hair, a single use of drug will not typically be detected during a hair



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analysis. Rather, hair testing is best used to answer the question "Did the subject chronically use a drug within the past X months?" (where X is related to the length of the hair). It does not answer the questions "Has the subject ever used this drug?" or "Did the subject use this drug on any occasion within the past X months?"

Hair analysis results have been accepted in a number of legal forums including divorce, child-custody, insurance and pre-employment cases, and wider applications in law enforcement investigations and military drug testing cases has recently been noted. At this time, National Medical Services provides hair testing for most common drugs of abuse, with the exception of marijuana. Testing for other drugs in hair are available upon request.

The forensic acceptability of hair testing relies on the same administrative and scientific underpinnings as tests for drugs in other body fluids and tissues. A chain of custody must be used to document the collection, preservation, shipping, laboratory handling, testing and eventual destruction of the sample. This permanent record provides an audit trail which can be scrutinized at a later date to answer questions regarding maintenance of specimen integrity. NMS provides a collection kit which meets all criteria for forensic acceptability. The testing regimen must be forensically supportable as well, so two separate analytical techniques are applied to two separate portions of the hair sample. Both of these tests must identify the drug or metabolite in order for the positive test results to be forensically defensible.

There are some indications that hair treatments, such as bleaching or coloring, may degrade drugs contained within the hair. Unfortunately, these anecdotal data do not allow for quantitative assessment of the extent or nature of decomposition to be expected from a particular hair treatment. However, treatment of the hair does not necessarily alter the hair content of all drugs, so analyses should still be performed in cases where a hair treatment has been performed. While treatments may confound interpretation of some hair testing results, they in no way are a contraindication for performing the tests.

Since the cuticle of the hair is typically coated with oils from the scalp, environmental smoke particles easily adhere and are carried by the individual until shampooing occurs. The issue of environmental contamination by secondary Crack (cocaine) smoke has been raised as a contributing factor in cases where cocaine is identified in a subject's hair. For this reason, National Medical Services' hair testing method involves multiple washes of the hair with organic solvents or aqueous buffers, in order to remove externally-coated traces of drugs. Following these washes, the hair is digested to release the drug contained within the cortex, and this digested hair sample is then analyzed. In addition, the final washing is analyzed, and if detectable traces of the drug are found in this wash the analysis is performed again. This process is repeated until the last wash is free of detectable traces of drug.

The scientific community has pointed out some of the issues remaining to be explored with regard to hair drug testing. These include studies to determine the exact manner of drug incorporation into hair, the heartiness of drugs in different hairs given different treatments, and the best methods to be used for testing all drugs. This field of scientific discovery continues to provide new insights into the study of drug abuse, and has provided many new capabilities for fact-finding in related forensic investigations.