Addiction Medicine
and the Primary Care Physician

Chemical Dependency and Drug Testing in the Workplace

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Urine testing for drug use in the workplace is now widespread, with the prevalence of positive drug tests in the work force being 0% to 15%. The prevalence of marijuana use is highest, and this can be reliably tested. Though it is prudent to rid the workplace of drug use, there is little scientific study on the relationship of drug use and workplace outcomes, such as productivity and safety. Probable-cause testing and preemployment testing are the most common applications. Random testing has been less accepted owing to its higher costs, unresolved legal issues, and predictably poor test reliability. Legal issues have focused on the right to policy, discrimination, and the lack of due process. The legal cornerstone of a good program is a policy that is planned and agreed on by both labor and management, which serves both as a contract and as a procedure in which expectations and consequences are known.

The National Institute on Drug Abuse is certifying laboratories doing employee drug testing. Testing methods when done correctly are less prone to error than in the past, but screening tests can be defeated by adulterants. Although the incidence of false-positive results is low, such tests are less reliable when the prevalence of drug abuse is also low.

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Alcohol and drug abuse is estimated to cost our nation more than $160 billion per year in lost productivity, health care costs, and crime. We are continually reminded in the news media of the ever-present effects of drug and alcohol abuse. Health care professionals see the effects of drug and alcohol use on the health of our population. The annual cost of therapy for alcohol and drug abuse is $1.6 billion.[1,2] Drug abuse has extended into all levels of society including the workplace. To rid the workplace of drugs, the prevalence of drug abuse needs to be known as well as whether, in fact, such abuse is directly related to workplace outcomes such as productivity, safety, and product integrity. If drug testing is one method of lowering the incidence of drug abuse in the workplace, will it be cost-effective if drug use is less prevalent than we have estimated, and will drug testing be effective in solving this problem either by deterrence or remediation?

Much of what is estimated about the use of drugs in the workplace is from survey or interview data that have been extrapolated to the general population. This is reasonable to do because a sizable proportion of the general population is working. Some of these data, however, are biased toward an overestimation because of their focus on drug abusers within sampled populations. Many surveys have focused on specific populations such as patients attending hospital emergency departments, clinical laboratory results, drug user "hotlines," poison control center phone calls, reports from medical examiners, drug enforcement agency confiscations, and drugs used by intoxicated drivers.[3-6] While such reports tend to emphasize the seriousness of the drug abuse problem, they do not actually estimate the prevalence of drug use in the workplace.

The credibility of alcohol and drug use estimates has recently been called into question.[7-9] Past estimates from the National Institute of Mental Health on the number of persons with alcoholism in the United States were, in part, based on a survey questionnaire that did not include questions about alcoholism per se.[7] Drinking behavior and how it is defined have changed over the years, making comparisons with past estimates less intelligible. Larger surveys by the National Institute on Drug Abuse (NIDA), the National Household Survey on Drug Abuse and the High School Seniors Survey, have inherent errors due to self-reporting. Adolescent survey respondents tend to overestimate actual drug use. Nevertheless, it is alarming to note that 36.3% of high school seniors have used marijuana and 10.3% have used cocaine in their lifetimes. Studies recently done by the National Institute of Mental Health have indicated that in a survey of 20,000 people covering five geographic areas across the United States, 6.8% have alcohol abuse or dependence problems and 2% abuse or are dependent on illicit drugs.[7] These data still do not direct us to the magnitude of the problem of actual drug abuse in the workplace.

Within the medical workplace, 3% of physicians have a history of drug dependence and 10% admit currently using

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ABBREVIATIONS USED IN TEXT

GC-MS = gas chromatography-mass spectrometry
MRO = medical review officer
NIDA = National Institute on Drug Abuse
PCP = phencyclidine hydrochloride

psychoactive drugs monthly.[10,11] In randomly selected tractor-trailer drivers whose blood and urine were tested for drugs during truck weighing in Tennessee,[12] 15% were positive for cannabinoids, 12% for nonprescription stimulants such as phenylpropanolamine, 5% for amphetamines, and 2% for cocaine. Alcohol was detected in only 1% of the sample. Of recruits for the Chicago Police Department, 20% tested positive for cannabinoids.[13] Actual drug testing data from various laboratories engaged in providing services to industry have indicated that the overall number of positive tests in preemployment testing is around 12% (primarily marijuana), whereas limited random testing data suggest that positive urine tests from currently employed workers is about 2%, primarily due to marijuana. One large testing laboratory has reported the results of testing from seven transportation companies over several years.[14] The rate of drug-positive urine specimens varies from 3% to 16% among these companies. These rates reflect a mixture of test settings including preemployment, random, and probable-cause testing. The data of actual drug use in the workplace are limited. Some have criticized the focus on drugs as misguided because alcohol abuse is a much larger problem and accounts for a larger proportion of morbidity in terms of health effects and accidents.[15]

Even more unclear is the relationship between drug use or abuse and productivity and safety in the workplace. Clearly, workers who are guardians of the well-being of others should not risk the safety of others by using drugs. The general consensus that any chemical may affect judgment or performance is a safe and cautious one. Drugs are often implicated circumstantially in accidents where a cause is not proved. For example, the often-cited air crash aboard the aircraft carrier Nimitz involved drug users. At that time in 1981, it was estimated that 47% (both by survey and direct testing) of sailors used at least one illicit drug, usually marijuana.[16-18] When this disaster occurred, those killed on the flight deck were tested and, not surprisingly, half of these sailors tested positive. In this case, the prevalence of drug use by the sailors on the flight deck merely reflected the prevalence of drug use within the US Navy itself and may not necessarily prove a causal role in this accident. As a corollary, the 65 deaths and 6 accidents aboard US Navy vessels in 1989 seem to have little relationship to the current 3% prevalence of drug-positive urine tests.

The effects of drugs on human performance are not uniform. While alcohol use will clearly alter cognitive and motor function, other drugs are not so well studied. Even in the forensic area of drug-intoxicated drivers who are arrested following accidents or because of the appearance of driving while intoxicated, experts do not agree on which types of human function might be altered by individual drugs.[19] For example, marijuana use may not affect reaction time in terms of stimulus-response reflex, but it can reduce attentiveness.[20-22] Generally the predominant effects of marijuana on behavior and physiology do not last longer than four hours after a marijuana cigarette is smoked, but decrements in performance during complex situations among airline pilots have been measured as long as 24 hours after a dose.[22,23] In conflict with the general assumption that marijuana affects workers' performance are the findings of a study that allowed workers to buy either tobacco cigarettes or marijuana cigarettes. Those using their money to acquire marijuana and smoking as many as 12 marijuana cigarettes each day for the period of the three-week study did not show a difference in work output.[24]

Drug use and abuse is a real problem in society, but the effects of drug use on worker performance and safety need better documentation for us to accurately address these problems. The study of actual illicit drug use, defined dosages, temporal relationships, and effects on work-modeled or real workplace tasks should be addressed with respect to each specific drug in question.

Goals of Employee Drug Testing

Workplace drug testing may connote both punitive and remedial intent. The anticipated effect of workplace drug testing would be to deter drug use if the consequences of detection are undesirable to the individual user. Detection alone is of little value unless the drug use is discontinued. Most major corporations that have embarked on drug testing have taken remedial action rather than punitive action by providing employee assistance programs. Such programs may reduce costs by providing rehabilitation of an existing employee who "knows the ropes," instead of training a new worker. The overall goals of employee drug testing include improving workplace safety, productivity, and product integrity so that the individual industry will have an improved fiscal bottom line.

Approaches to drug testing have included preemployment, probable cause, safety sensitive, and random testing. Preemployment testing is the most popular type of drug testing program and perhaps the most effective, with the least liability to the employer. Between 60% and 70% of small businesses in one eastern city[25] and 80% of Fortune 500 companies with drug testing programs use the preemployment testing approach.[26] Over a period of years, preemployment drug testing would be expected to lead to a lower incidence of drug use in the work population when drug users are screened out before being hired and old workers leave the work force by natural attrition. Probable-cause testing is useful in enhancing the presumption of drug use when poor performance is observed, evidence of intoxication is witnessed, or after accidents thought to be caused by intoxication. Supervisors and employees can be instructed to recognize the signs of drug intoxication. While the detection of drugs in the urine has no accurate relationship with behavioral or pharmacologic effects, combining witnessed behavior with drug detection can provide a reasonable presumption that drug abuse or drug effects were present.

The random testing of workers by industry is a less popular approach in that it has several shortcomings. To identify most of the drug users in a population using a random testing approach, urine specimens must be collected relatively frequently compared with the period of time that drugs may be present in the urine (Table 1). Random testing should be unannounced so that drug-using workers may not anticipate the time of drug testing and abstain from drug use during that period. This requires an added level of administration and management that may be more costly. While many approaches to drug testing have been examined in the courts

TABLE 1—*Time Intervals for Detecting Drugs in Urine After Use at Cutoff Concentrations*

NIDA-Recommended Drug Tests	*Days Detectable After Use*
Marijuana metabolite	
Single use	< 7
Ongoing abuse	<30
Cocaine metabolite	< 3
Opiate metabolite	< 2
Phencyclidine	< 7
Amphetamines	< 2
Others	
Alcohol	< 1
Barbiturates	< 2
Phenobarbital	< 7
Benzodiazepines	< 3
Methaqualone	< 7
Methadone	< 4

NIDA = National Institute on Drug Abuse

(safety sensitive, probable cause, and preemployment), the legality of random testing programs has not been decided. Because of the potential for infringing on the right of privacy of individual workers (discussed later) some industries are steering away from random testing (J. Hoerr, K. M. Hafner, G. Degeorge, et al, "Privacy," *Business Week,* March 28, 1988, pp 61-68). While the specificity of drug testing (low false-positive rates) is good when done properly, a low efficiency of such testing may occur when the prevalence of drug abuse is also low. Whenever the prevalence of a test condition (drugs being present) approaches the specificity of a test, the number of false-positive tests relative to the number of true-positives will be high. For instance, phencyclidine hydrochloride is a drug relatively rarely encountered in workplace drug testing programs. If 1 in 1,000 workers actually had phencyclidine in their urine and only 1 in 1,000 false-positive tests occurred in the testing procedure, then half of the positive results in such testing would be false-positive. Clearly, random testing should not be applied to types of drugs with very low prevalence.

This raises the question of which drugs should be tested for. Employers have the choice when working with laboratories to select tests for drugs they think are problematic. Marijuana and cocaine are the drugs most often detected in surveys and programs. Opiates, amphetamines, and phencyclidine are less common. Other drugs, such as barbiturates and benzodiazepines, may also be included in such testing because their use is often encountered among polydrug users. Some drugs in some regions of the country or in certain industries may not be perceived as a problem. If that is the case, employers may wish to spend their money in another area with a higher rate of return.

Recently two studies have shown minimal effects of preemployment drug testing. One study screened all new employees and kept results confidential for a year. Of all the new employees, 12% had tested positive for drug use. There were no differences between drug-positive and drug-negative employees when job performance variables were compared—evaluations and job retention—at the end of the year. Eleven drug-negative employees were fired and no drug-positive employees were fired during the period of this study.[27] In another study, 3,600 workers were hired by the US Postal Service during 1987 and 1988. Overall, 8.4% of all workers hired had positive drug tests (*Clinical Chemistry News,* March 1989, p 8); 13.3% of workers with positive drug tests were fired within six months compared with 9.5% of workers with negative drug tests. While the effects of drug use on work performance have been difficult to document, uncontrolled data from industry have suggested that drug testing in the workplace has been efficacious. Southern Pacific Railroad has indicated that its accident rate has decreased from 10% to 5% over a three-year period of drug testing.[28] General Motors has claimed a greater than 40% reduction in absenteeism, 50% fewer disciplinary actions, and 50% fewer accident claims by employees (J. Castro, J. Beaty, B. Dolan, et al, "Battling the Enemy Within," *Time,* March 17, 1986, pp 52-61). The drug testing program of the military has been exemplary. In the US Navy, the most common drug detected was marijuana. The overall positivity rate has fallen from 48% in 1980 to 3% in 1987.[16,17] While these numbers reflect actual test positivity rates, the numbers from 1980 must be viewed with some skepticism because of the different testing techniques and criteria used in 1980 versus 1983 and thereafter.[17,18]

Because observations in industry have been uncontrolled, critics have argued that drug use may be reduced by deterrence and fear of consequences, but that improvements in safety or productivity may be coincidental. For instance, when accidents occur, attentiveness is subsequently heightened and preventive measures are taken that may reduce accident rates. Also, drug testing has been instituted at a time of labor union weakness and union-busting tactics. Employees may refrain from drug use for fear of losing their jobs in this general milieu. The "Hawthorne effect" can be postulated to be at work because this extra attention to workers and their conditions may improve productivity and morale. Cause and effect have not been documented. Even a corollary hypothesis may be invoked: that poor working conditions with attendant unsafe practices, low worker morale, and low productivity may lead to increased drug use. Overall, drug testing has been viewed as successful in highly regimented situations such as the US Armed Services or in highly focused applications such as preemployment or probable-cause testing.

Legal Issues

The legal issues that have surfaced in the development of drug testing programs have been reviewed extensively by others.[29-36] Concerns have focused primarily on the right to privacy or lack of probable cause as guaranteed by the 4th Amendment of the Constitution, equal protection with respect to the application of the law by the 14th Amendment, the application of due process and the admissibility of drug test results by the 5th Amendment, and contract law with respect to policy agreements between employers and employees. Also of consideration are government legislation and local law.

While several constitutional and human rights issues have been evolving during the implementation of drug testing in the 1980s, the legal cornerstone of drug testing programs is the emplacement of a policy agreement. Such a policy is a contract between employers and employees. As such, it should be negotiated in advance by both parties and agreed on with respect to the conditions of testing, the procedures for collecting specimens, and the consequences of the test results. Each step in this pathway should be definitively de-

lineated so that choices and contingencies are made by the policy itself and not by others acting after the fact. Employers should guard that policies are evenly applied, are nondiscriminatory, and allow a tested employee adequate recourse to any decision made regarding the employee. Furthermore, each program should include an employee assistance program (see the relevant section). In adopting such policies for drug testing, employers should be aware that local regulations or state legislation may have recently been enacted that affects how such programs would be conducted.

Selecting a group of persons to test without prior suspicion may lead to an allegation of bias or an absence of equal protection. In a ruling against the National Collegiate Athletic Association, the 14th Amendment was cited in part as protection against selecting a group of athletes for drug testing without demonstrating a likelihood that drug use was prevalent in that population. In this particular circumstance, college athletes other than male football and basketball players were found not to have a prevailing drug problem that required testing based on the actual test results in each sport. Due process must be given to a person considered for drug testing. This applies not only to the acquisition of a urine specimen as described by policy procedures, but also with respect to the admissibility of drug testing evidence in court actions. Drug testing techniques must have general scientific acceptance (Frye versus United States)[37] but are not required to have absolute accuracy, only beyond a reasonable doubt (California versus Trombetta).[38]

The most difficult area of constitutional law relates to the 4th Amendment, which prohibits the federal government from unreasonable search and seizure activities. In most cases where there was probable cause, drug testing procedures have been upheld. When applied randomly—that is, without individualized suspicion—the courts have had difficult decisions before them. Some legal opinion has extended the prohibiting of unreasonable search and seizure to an intrusion into individual private lives for both government and private sectors. Other interpreters of the Constitution have suggested that the framers of the Constitution did not intend to protect the private act of illicit drug use but were concerned with the privacy of family life, public service, and economic practices. Executive Order 12564 by then-President Ronald Reagan in 1986 has been applied slowly, primarily to the random testing of employees in safety-sensitive positions, wherein the public concern for safety (such as with airline pilots) or the corruption of a process (customs agents) has been held as exceeding the rights to privacy of the individual. For example, in prison guards who were searched and tested for drugs, a lower court ruled that probable cause should be required before testing. A higher court reversed this decision, indicating that a lack of drug use was necessary for the job function being performed.[39] Drug testing of employees in certain critical positions has been favored as being a type of "fitness test."

Several cases have been decided in favor of the plaintiff because of the invasion of privacy and protection under constitutional law (Luck versus Southern Pacific Transportation Company, Price versus Pacific Refining Company).[40,41] Rulings in favor of the plaintiffs in these cases were contingent on the lack of probable cause and the poor implementation and practice of a policy agreement. A higher court ruling may still be heard in these cases. Also, there are examples of several local jurisdictions that, without adequate policy agreements, have tried to coerce employees into providing urine specimens for drug testing. Such actions, no matter how likely the actual drug problem, were doomed to fail.

Testing Procedures

For years, many laboratories have been capable of measuring drugs and their metabolites in biologic fluids. These measurements have been used in a number of different circumstances, including clinical emergency toxicology (drug overdose cases), medical examiners' investigations (cause of death determination), methadone testing programs, and therapeutic drug monitoring practices. Until recently, the many different techniques and approaches to detecting drug use have been unique or suited to those particular situations, but widely varied between them. With the development of the National Institute on Drug Abuse guidelines for federal employee drug testing programs in 1988,[42] there has been consensus regarding the types of methods to be used in such testing.[43,44] The following conditions cause employee drug testing to be different from other forms of drug testing:

- The concentrations of drugs are usually lower than in emergency toxicology cases, coroners' cases, or tolerant methadone patients.
- The prevalence of drug use in the populations being tested is often much lower in employee drug testing programs than in selected populations of drug users (methadone testing) or cases where a particular drug is highly likely to be present (clinical signs and history of drug overdose).
- The assurity or reliability of the test result in employee drug testing should be greater than in other forms of drug testing because the drug test results may provide the only evidence that a drug was in fact present. In other clinical testing circumstances, the past history or clinical signs may provide additional evidence and a higher probability that a drug may be present (therapeutic drug monitoring, emergency toxicology). Also, the action or consequence of the drug testing may be more severe for those who have been falsely accused. Thus, the methods for drug testing in the workplace must be both highly sensitive and specific.
- The search for drugs in employees is a focused or a narrow one (usually five illicit drugs or classes) as opposed to a broad search for any drug that might be causing clinical symptoms as in a case of overdose in a hospital emergency department.

Testing for marijuana and cocaine, the two most commonly abused drugs, appears to be the most productive, but the advocates of drug testing programs have been criticized for not including the most common of all abused drugs—alcohol. As stated earlier, programs that focus on drugs abused in very low prevalence may also be misguided because false-positive results may outnumber true-positive results when the prevalence approaches the specificity of the testing.

The NIDA has prescribed that the initial screening test be an immunoassay (radioimmunoassay, enzyme immunoassay, fluorescent polarization immunoassay) for the five major illicit drugs of abuse: marijuana, cocaine, amphetamines, phencyclidine (PCP), and opiates.[42] Positive results by the initial screening methods would then be confirmed subsequently by gas chromatography-mass spectrometry (GC-MS). The cutoff (detection of the presence of the drug) concentrations of these methods are listed in Table 2.

No method has absolute accuracy, and any can be fooled by similar drugs or intentional adulteration. Drug testing results may be inaccurate because of analytic false-positive or -negative findings or owing to the misapplication of the results. Usually, drugs or chemicals that produce false-positive or -negative results in the screening assay will not produce the same problem in the confirmatory assay. Agents initially causing a false-negative test, however, might not produce further confirmatory testing. Therefore, the aim of drug users wishing to avoid detection has been to interfere with the initial immunoassay screening test. Fluorescent polarization immunoassays for barbiturates and benzodiazepines can be rendered falsely positive by the use of nonsteroidal anti-inflammatory agents such as ibuprofen.[45] Also, the presence of fluorescein dye in the urine may prevent determination by fluorescent polarization immunoassays.[46,47] Gas chromatographic-mass spectrometric procedures can also be fooled. It has recently been shown that ibuprofen will cause a false-negative result in some GC-MS confirmatory tests for marijuana metabolites. This is probably due to the consumption of the derivatizing agent by ibuprofen, which is necessary to make marijuana volatile for gas chromatographic analysis.[48] Other immunoassays, such as enzyme immunoassays, have been shown to produce false-negative results by additives such as benzalkonium chloride (an antiseptic used topically and as an antimicrobial preservative in ophthalmic solutions such as Visine eye drops), vinegar, lemon juice, goldenseal *(Hydrastis canadensis)* tea, lye crystals for unplugging drain pipes, and liquid soap. All but the benzalkonium chloride are required in high concentrations and are easily detected by simple means such as determining the pH, specific gravity, shake tests for foaming, creatinine concentrations, and osmometry. The use of benzalkonium chloride from Visine eye drops has been shown to cause false-negative results in enzyme immunoassays for marijuana and cocaine and can only be ruled out by testing specifically for benzalkonium chloride.[49-52] A recidivistic drug user may use other approaches such as diluting the urine specimen with toilet water, substituting for the urine specimen a known drug-free urine specimen, ingesting substances that dilute the urinary concentration of the drug to be detected (drinking water, taking diuretics), ingesting acidic salts such as ammonium chloride to hasten the excretion of basic drugs before the urine collection or ingesting basic salts (sodium bicarbonate) to reduce the excretion of basic drugs during collection.

Apart from these purposely added or ingested adulterants that may cause false results, a potential problem is the misidentification of drugs taken innocently without pharmacologic effects or therapeutically. Usually the confirmatory testing procedures can rectify the misidentification caused by a cross-reactivity of the immunoassays with similarly structured drugs. Drugs that cross-react with the initial screening immunoassay test are listed in Table 3. For the opiates, medications with codeine, hydrocodone bitartrate (cough syrups), and oxycodone hydrochloride will cause the initial immunoassay to be positive for opiates. Subsequent GC-MS will differentiate these drugs from morphine. Similarly, over-the-counter stimulants such as dietary aids and decongestants (phenylpropanolamine, fenfluramine, and ephedrine) may cause the initial immunoassay screen for amphetamines to be positive. Again, GC-MS differentiates these from illicit amphetamines. Consuming poppy-seed-containing foods (bagels, poppy-seed cakes) will produce detectable amounts of morphine in the urine without sufficient amounts reaching the systemic circulation to produce any pharmacologic effects. Usually the morphine derived from the use of heroin (diacetyl morphine) must be metabolized to monoacetyl morphine and morphine. Therefore, to differentiate poppy-seed use from heroin abuse, the presence of monoacetyl morphine in a GC-MS analysis will implicate heroin use.[53,54]

Actual false-positive tests are rare when these two testing procedures are combined. The only standardized way of assessing the accuracy of employee drug testing is by providing proficiency test specimens for laboratories to test in an open or a blind manner. Recent studies on employee drug testing have shown that laboratories using these methods are highly accurate, having very low false-positive rates when focused on only the five drug classes.[55,56] A number of writers have concentrated on proficiency testing results that are not applicable to employee drug testing. Unfortunately, these results have also received media attention. Most of the previously published reports on proficiency testing results have surveyed laboratories doing work for methadone drug testing centers and hospital emergency toxicology services. As indicated, the concentrations of drugs, the number and types of drugs, the prevalence of drugs in the population tested, and the techniques used in these different situations are not comparable.

Calibration and in-house quality-control checks are routine in any laboratory. In addition, the NIDA guidelines for

TABLE 2—*NIDA-Recommended Cutoff Concentrations in Urine (ng/ml) for Workplace Drug Testing*

Drug	*Immunoassay Screen, ng/ml*	*GC-MS Confirmation, ng/ml*
Marijuana metabolite*	100	15
Cocaine metabolite†	300	150
Opiate metabolite	300‡	300§
Phencyclidine	25	25
Amphetamine	1,000‖	500¶

GC-MS = gas chromatography-mass spectrometry, NIDA = National Institute on Drug Abuse

*Δ-9-Tetrahydrocannabinol-9-carboxylic acid.
†Benzoylecgonine.
‡Total conjugated opiates; 25 ng/ml if by radioimmunoassay for free morphine.
§Either codeine or morphine after hydrolysis.
‖Total reacting amphetamines.
¶Either D-amphetamine or methamphetamine.

TABLE 3—*Common Cross-reacting Drugs in Screening Immunoassays*

*Amphetamines**	*Opiates*
Phenylpropanolamine	Oxycodone
Pseudoephedrine	Hydrocodone
Ephedrine	Hydromorphone
Phenylephrine	Codeine
Phentermine	*Marijuana metabolite*
Propylhexedrine	NSAIDs before 1986
L-Methamphetamine†	Naltrexone, nabilone do *not* cross-react
Fenfluramine	*Cocaine metabolite*
Other amines	Local anesthetics and atropine do *not* cross-react

NSAIDs = nonsteroidal anti-inflammatory drugs

*Several manufacturers (SYVA, Abbott) now make a more specific immunoassay for amphetamines that cross-react less with other amines.
†In Vicks Inhaler (as desoxyephedrine).

contractors with federal agencies require that 50% of all specimens submitted by the agency in the first quarter should be blind quality-control specimens. About 80% of these urine specimens should not contain drugs. In subsequent quarters, 10% of the specimen load is to be for the purposes of blind quality control. It is required that the cost of preparing and testing these specimens is to be borne by the submitting agency. Also, ten proficiency testing specimens are sent every two months to the laboratories certified by the NIDA program. Any false-positive test requires consideration for recertification of the laboratory and a reanalysis of previous contract specimens. To date, of the initial 100 laboratories that applied, only about 40 have been certified by NIDA. More than 60 had dropped out because of the stringent requirements (including a one-week inspection and operations observation). Others have had difficulty because of the added requirement of quantitation (determine concentration) during the GC-MS confirmatory procedures.

The reliability of any test depends on the previous probability of the test condition being present and the analytic sensitivity and specificity of the test. If the tests for marijuana and PCP are both 99.9% specific (0.1% false-positives) and these two tests are applied to a population of 1,000 persons where only 1 person has PCP in their urine and 100 have marijuana metabolite in their urine, the reliability (predictive value, posterior probability) of a positive test for marijuana in this situation is 99% and for PCP is only 50%. While both tests have the same analytic specificity, the relative number of false-positive to true-positive tests will be much higher in the low-prevalence situations—that is, PCP use.

In addition to testing urine to detect drug use, hair analysis for drugs has been investigated. Many drugs have been detected in hair, but the interpretations of these tests are at present vague. Although hair specimens can be obtained repeatedly and noninvasively, can be identified as belonging to particular persons, and are less likely to be adulterated, drugs present in hair cannot substantiate current use. Therefore, hair analysis is unlikely to be used in probable-cause testing. Also, hair as a specimen suffers potentially from external passive contamination. Hair analysis was reviewed recently by Baumgartner and co-workers.[57]

Testing Programs

Before establishing a drug testing program and developing the necessary policy to make such a program work, the need for such a program should be established and documented. If a drug abuse problem has been shown to be present in a particular workplace, it is more likely that all those concerned—employers, employees, unions, regulatory agencies, and legislative or legal bodies—will be able to join forces in efforts to help solve the drug problem. In the absence of a clear need for a drug testing program, accusations of bias or discrimination may be charged more easily. Documenting a drug abuse problem may take several forms, including the witnessed behavior of intoxication or drug dealing on the job, increased accidents in an environment of suspected drug use, or anonymous pilot testing of employees to document the presence of drugs. In one workplace where almost 500 preemployment tests were done, only one PCP-positive employee was found at a cost of more than $16,000 for the testing alone.[58] This might not be considered cost-effective, but if that person were to cause a costly accident or error, these dollars may have been well spent.

The development of a policy for drug testing should include the following:

- A statement of the need for drug testing and why drug use is unacceptable;
- Policy development should be an ongoing process that involves comment and consideration from the employees. It is also in the employees' interest to have a safe, productive, and profitable workplace;
- The procedure for collecting urine specimens should be clearly and definitively stated so that employees know exactly what is expected;
- All procedures should be standardized to ensure a fair application to all employees. These procedures should be carried out on a mock basis to ensure they are actually workable before the first employees are entered into the process;
- The consequences of detection should be clearly stated for each alternative;
- Alternatives must include remediation and rehabilitation.[35,42,59]

Following agreement among the participating parties, the actual procedure should be defined. If random testing is to be done, choosing the appropriate time for collection may present some difficulty. If employees are aware or notified that collections will occur, the purpose of the program may be defeated. If random collections are not frequent enough, testing would tend to identify only continuous abuse. Random collections may be made at times when other activities are scheduled within the operations of an industry. For example, collections may be done during routine medical examinations (annual physicals), during corporate health surveys, during operations shutdowns for preventive maintenance or safety inspections, and during insurance enrollment periods. Other random collection techniques include the checking of random portions of the worker population. For instance, using random number generation, only 10% of the work force would be sampled.

Other specimen collection schemes relate to the program, whether probable cause, safety sensitive, or preemployment. Probable-cause testing is the most common program for testing currently employed workers. The written documentation of witnessed behavior that corroborates test results is extremely important in such a program. Employers should be instructed as to what signs to observe in a worker who is suspected of intoxication. Because probable-cause testing only tests persons who have been presumed to use drugs because of their behavior or symptoms, only the worst offenders are likely to be identified. It is usually preferable that a worker's supervisor document his or her observations and accompany the person who is under suspicion of drug use to where a urine specimen would be collected.

The urine specimen should be collected in an area away from use by other employees so that the occurrence of testing does not become public knowledge. The direct observation of urination is not absolutely necessary, but some precautions should be taken. The subject to be tested should not be allowed to carry extra garments, purses, or packages into the toilet area. The toilet area should be free from other cups, containers, or water faucets. The toilet water should be dyed with a commercial sanitary indicator. Although drug users in methadone programs or the criminally incarcerated have sophisticated techniques to adulterate urine or escape detection, such sophistication is not commonplace in the work

force. Therefore, direct observation is considered more of an invasion of privacy than a necessary or valid procedure. Once the urine specimen is collected, the temperature should immediately be measured and recorded; it should be within 2°C of the body temperature. The urine specimen should then be closed and sealed. The employee and the person who is witnessing the collection process should initial and date the seal or the label of the container and sign a log book that is kept on the premises. Special tamper-proof containers with seals that will tear irreparably when opened can be purchased for such drug testing. Specimens to be transported to laboratories for testing should be packaged in tamper-proof courier bags or locked boxes with the keys or combinations known only by the laboratory. Attached either to an individual specimen or the box of specimens should be a list of the persons who have handled the specimens, and their signature should record their contact with the specimens.[42,59]

The laboratory should report only confirmed positive results; all other test results are to be reported as negative. Reporting results such as "trace," "positive but unconfirmed," or "unknown substances present" should be strongly discouraged. Policy should provide for the retesting of a specimen at a laboratory of the employee's choice. Medical review officers (MRO) are considered an important component of drug testing programs and are mandated for federal programs.[42] Their duties include the understanding of how tests were done, how specimens were acquired, how to interpret the results, and what courses of action can be taken. A designated MRO also serves as a person outside the corporate structure who can confidentially review with the employee the results of testing and the circumstances leading to positive test results. In so doing, the MRO must understand what are the cutoff concentrations for individual drugs and the period of time during which individual drugs can be detected. The MRO must also understand which drugs and conditions may alter the results of drug testing. Most important, the MRO must be able to communicate the meaning of test results to administrative personnel who may take action against the individual employee. Drug test results *do not* indicate the following: They do not reveal the extent of use. A positive drug test result may indicate either solitary one-time use or continual abuse of a particular drug. Urinary drug testing does not correspond to either pharmacologic effects or effects on workplace performance. Drug test results only record that the drug was present in the urine. Drug test results do not indicate when the drug was taken or how much was taken.

The courses of action available to an MRO should be guided explicitly by policy. The alternatives that the MRO may choose from include no action, explanation by the employee of conditions leading to the positive test, an investigation of medications that may have been prescribed, repeating the test with a full explanation of consequences when a second specimen is positive, a change of position within the company, a leave of absence, further performance evaluation, resignation, and termination. With all of the above alternatives, counseling and treatment should be provided through a practitioner with experience in drug abuse and rehabilitation.

Employee Assistance Programs

Chemical dependency in the workplace may present as acute intoxication, chronic abuse, withdrawal, or as accelerated medical complications of chemical dependency such as liver disease. Intoxication, withdrawal, and medical complications of chemical dependency are more obvious but occur less frequently than the more subtle, less specific signs of drug use such as absenteeism, tardiness, or accidents.

The key to intervening and treating a drug user is early identification and the institution of care.[60,61] As an outgrowth of occupational alcoholism programs, most Fortune 500 companies now have some form of employee assistance program. Employers can encourage employees to use such programs. Because of the tendency for a troubled employee to deny the extent of his or her addiction, intervention techniques have been developed for the purpose of directing identified persons into a structured program. Denial may go beyond the affected person to involve co-workers, supervisors, and family. An effective intervention makes clear to a chemically dependent worker that both health and economic livelihood are at stake. The clinicians conducting the intervention may use family members and co-workers familiar with the troubled employee's deteriorating physical and emotional states.

After an appropriate clinical evaluation is made by either a member of the company's employee assistance program or a consulting clinician, the next step is directing the substance-abusing person into treatment.[62] In some case evaluations, what is perceived as behavioral problems associated with possible drug use may be the clinical manifestations of a primary emotional disorder such as depression. If chemical dependency is diagnosed, the employee might be referred to a 28-day inpatient drug treatment program. If a primary emotional disorder is diagnosed, a referral may be made for outpatient psychotherapy. Treating an emotional disorder will not be effective unless chemical dependency is also treated, and the 28-day inpatient treatment programs have become the standard for treating chemical dependency. The cost of such programs is high, and for some employees with less-than-optimal health insurance coverage, a more circumscribed period of inpatient care can be followed by care in a halfway house or residential treatment setting.

Several models exist for the treatment of chemical dependency.[63] The need for self-participation is stressed by Alcoholics Anonymous and Narcotics Anonymous. For a recovering alcoholic or drug addict, this self-help group approach is often crucial in maintaining a state of sobriety. Most treatment programs use some form of group psychotherapy in addition to the "12-Step" approach of Alcoholics Anonymous. It is often only through the group context that a chemically dependent worker can come to terms with his or her long-term avoidance of the acknowledgement of the addictive process and its negative effects on the person's life. Other psychotherapeutic modalities may include individual and family therapy.

Chemically dependent workers usually require a defined structure, guidelines, and rules. The inpatient treatment model is often the best means for initially creating such a framework. A medical history and physical examination with appropriate laboratory testing are necessary on entering treatment. The greatest chance of success with a chemically dependent worker occurs when the program emphasizes total abstinence, but even with such measures "slips" do occur. Chemically dependent adults must consider themselves "in the process of recovering" on an indefinite basis. Persons with alcoholism may require pharmacologic support with

disulfiram to decrease their recidivism. A medical evaluation may indicate the need for an antidepressant medication or lithium carbonate for treating an associated affective disorder.

Occupational physicians should contribute to the design of employee assistance programs.[62] Such a program may be situated within a company or outside the company as a contracting service. All employee assistance programs should provide evaluation, treatment referral, follow-up, and employee education. Other services include short-term treatment, management training, drug monitoring, and organizational consultation to departments in the company. A properly run program maintains confidentiality in self-referral cases and makes clear the limited confidentiality in a management referral. Other planning functions of the medical consultant include a review of health insurance benefits for the treatment of substance abuse and psychiatric illness. Part of the cost-effectiveness of employee assistance programs is the educational effort directed at management and employees around the hazards of substance abuse. Managers can be instructed about the early warning signs of drug abuse. Employees can learn of the acute and long-term effects of alcohol and other substance use. The ultimate goal in such educational efforts is to encourage chemically dependent workers to seek assistance for their addictive disease.

As difficult as these problems are to treat, great satisfaction can be had in helping a dysfunctional, chemically dependent worker to return to a premorbid level of occupational and personal functioning. The professional challenge is great in overcoming the resistance to treatment on the part of the employee and the negative feelings engendered on the part of the health practitioner. While there is a need for flexibility in approaching any troubled person, companies and their consulting health care team should also have a set of policies and procedures for addressing the problems of chemically dependent and emotionally disturbed employees.

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