Inter-regional Tripartite Experts Meeting on
Drug and Alcohol Testing in the Workplace
Oslo (Hønefoss), Norway, 10-14 May 1993

Working Paper
on

CURRENT PRACTICE AND EXPERIENCE ON
DRUG AND ALCOHOL TESTING IN THE WORKPLACE

Prepared by
Craig Zwerling, M.D., Ph.D., M.P.H.

International Labour Office
Geneva
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>v</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. HISTORY OF DRUG TESTING IN THE UNITED STATES</td>
<td>1</td>
</tr>
<tr>
<td>2.1 Patterns of drug use</td>
<td>1</td>
</tr>
<tr>
<td>2.2 Military experience</td>
<td>2</td>
</tr>
<tr>
<td>2.3 Technological change</td>
<td>2</td>
</tr>
<tr>
<td>2.4 Federal initiative</td>
<td>3</td>
</tr>
<tr>
<td>2.5 Judicial challenges</td>
<td>3</td>
</tr>
<tr>
<td>2.6 The drug testing industry</td>
<td>4</td>
</tr>
<tr>
<td>3. RATIONALE FOR DRUG SCREENING IN THE WORKPLACE</td>
<td>5</td>
</tr>
<tr>
<td>3.1 Safety</td>
<td>5</td>
</tr>
<tr>
<td>3.2 Productivity</td>
<td>6</td>
</tr>
<tr>
<td>3.3 Reduction of drug use throughout society</td>
<td>6</td>
</tr>
<tr>
<td>3.4 Legislation and regulation</td>
<td>6</td>
</tr>
<tr>
<td>4. EMPLOYER DRUG TESTING PROGRAMMES: PRACTICE AND ATTITUDES IN THE UNITED STATES</td>
<td>7</td>
</tr>
<tr>
<td>4.1 Practices</td>
<td>7</td>
</tr>
<tr>
<td>4.2 Attitudes</td>
<td>8</td>
</tr>
<tr>
<td>5. THE EFFECTIVENESS OF WORKPLACE DRUG SCREENING IN REDUCING DRUG USAGE IN THE WORKPLACE</td>
<td>10</td>
</tr>
</tbody>
</table>
6. DRUGS, ALCOHOL AND OCCUPATIONAL INJURY

6.1 Fatal occupational injuries and alcohol

6.2 Non-fatal occupational injuries and alcohol

6.3 Fatal occupational injuries and drug use

6.4 Non-fatal occupational injuries and drug use

6.5 Alcohol, drugs and occupational injuries in transportation

7. DRUG TESTING AND OTHER ADVERSE EMPLOYMENT OUTCOMES

8. COST-BENEFIT ANALYSIS

9. FUTURE TRENDS AND POLICY CONCERNS

10. TABLES AND FIGURES

Table 1 - Alcohol and Drug Use Among Fatally-Injured Workers

Table 2 - Alcohol and Non-fatal Occupational Injuries

Table 3 - Drug/Alcohol Use Among Fatally-Injured Drivers and Un-injured Controls

Table 4 - Federal Aviation Administration Drug Testing Data, 1991

Figure 1 - Percentage of U.S. Non-agricultural Firms with Drug Testing Programmes by Number of Employees in Firm

Figure 2 - Percentage of U.S. Non-agricultural Firms with Drug Testing by Industry

11. REFERENCES
PREFACE

This paper on current practice and experience on drug testing programmes in the workplace has been prepared for discussion at the "International Tripartite Experts Meeting on Drug and Alcohol Testing in the Workplace" (Oslo, Norway; 10-14 May, 1993). The goals of the meeting include: (1) reviewing the need, rationale, and current experience with workplace alcohol and drug testing; (2) developing principles, guidelines, and pre-conditions to be followed if testing programmes are initiated; (3) suggesting specific rules and regulations to ensure the integrity of testing procedures; and (4) drafting a consensus statement on alcohol and drug testing in the workplace.

The following papers have also been prepared for more in-depth examination of various aspects of drug and alcohol testing in the workplace:

- "Overview and Perspectives on Drug and Alcohol Testing in the workplace", by Meredith Hanson;
- "Drug and Alcohol Testing in the Workplace: Moral, Ethical and Legal Issues", by Carl Raskin;
- "Types of Testing Programmes in the Workplace", by Jorg Moreland;
- "Drug Testing Methods and Clinical Interpretations of Test Results", by Bhushan Kapur.

This paper's purpose is to review current practice and experience in workplace drug and alcohol testing and serve as a catalyst for discussion and debate among the experts. As such, it tries not to present a position on workplace testing, nor does it offer specific recommendations concerning workplace testing policies and procedures. Rather, it reviews the history and rationale for drug testing, summarizes findings from studies on impact of drug testing, and highlights strengths and weaknesses from the literature on association of substance abuse and occupational injuries and employment outcomes.
1. INTRODUCTION

This paper examines the current practice and experience on drug and alcohol testing in the workplace, focusing primarily on the United States, where there has been the most experience. Section 2 reviews the history of workplace drug screening in the United States emphasizing the close ties between workplace drug screening and concerns about safety as well as describing the growth of the drug testing industry. Section 3 outlines four rationales for workplace drug testing: safety, productivity, decreasing drug use and legislative/regulatory requirements. Section 4 summarizes the best studies on the prevalence of workplace drug testing in the United States and looks at some employer attitudes. Section 5 describes the impact of drug testing in decreasing drug use in the U.S. military, while pointing out the difficulties in generalizing this experience to the civilian workforce. Section 6 reviews the literature on the association between alcohol, drugs and occupational injuries. Section 7 reviews the literature on alcohol, drugs and other adverse employment outcomes. In both Sections 6 and 7, special attention is given to assessing the strengths and weaknesses of existing literature. Section 8 discusses factors involved in conducting cost-benefit analyses of workplace drug testing. Finally, Section 9 discusses future trends in workplace drug testing and their implications for policy-makers. Throughout the paper the emphasis has been placed on describing what we know, where we don't have adequate data, and what types of research could fill in those gaps.

2. HISTORY OF DRUG TESTING IN THE UNITED STATES

2.1 Patterns of drug use

The emergence of workplace drug testing in the United States can be viewed in the context of changing patterns of drug use over the last three decades. In the years from 1955 to 1980, the United States experienced a twenty-fold increase in the non-medical use of drugs (Nicholi, 1983). During the 1960s, this "epidemic" was characterized by large-scale experimental use of marijuana, LSD and other hallucinogens by middle class and upper class youth (Ackerman, 1991). During the 1970s, drug use among young people in the United States increased in all social strata.

In the United States, national surveys can be used to track patterns of self-reported drug use. The National Household Survey on Drug Abuse began in 1971-72 and has continued since. These surveys show that marijuana use increased over the decade of the 1970s, reached a plateau in the 1980s and has begun to drop in the late 1980s and early 1990s. Cocaine use grew through the 1970s and early 1980s but then reached a plateau and has also begun to decrease. Among Americans over the age of 12, the number currently using (past month) illicit drugs dropped from 23 million in 1985 to 13 million in 1991 -- more than 40 per cent (National Institute on Drug Abuse, 1991). During the same time, current cocaine use dropped by about two-thirds. In 1991, among full-time employees, six per cent were current users of illicit drugs. Drug use varied significantly from industry to industry. Among full-time employees...
aged 18-34, current drug use ranged from 15.4 percent among construction workers down to 6.5 percent among professionals. In most industries, the percentage of current drug users in this age group has been decreasing since 1988 (National Institute on Drug Abuse, 1991). The annual Monitoring the Future Survey conducted by the Institute for Social Research at the University of Michigan showed a similar pattern of drug use among high school seniors in the years 1975-1990 (Johnston, 1991). The number of high school seniors who had used marijuana in the last year increased from 40 per cent in 1975 to 51 per cent in 1980 but has subsequently dropped to 27 per cent in 1990. Similarly, cocaine use increased from 6 per cent in 1975 to 12 per cent in 1981 but has dropped to 5 per cent in 1990.

2.2 Military experience

Much of the early experience in drug screening large numbers of people came from the U.S. military. The military had initially introduced urine drug screening to identify heroin users returning from Vietnam in the late 1960s and early 1970s. This programme was extended to screening soldiers reporting for active duty in the early 1970s. In 1980, the United States Department of Defense published a survey of substance abuse among active duty military personnel (Burt, 1980). Overall drug use in the military services was reported at 26 per cent. Among young enlisted men, ages 18 to 25, usage was as high as 47 per cent in the U.S. Navy and Marine Corps. In May of 1981, a Marine Corps aircraft crashed aboard the aircraft carrier Nimitz. Of 14 people who died, 9 revealed evidence of cannabbinoids in the autopsy. In addition, the pilot was taking a prescribed antihistamine without the knowledge of his commanding officer or flight surgeon. The publicity surrounding this crash accelerated the Navy’s decision to implement across the board drug screening.

2.3 Technological change

In addition, the increasing use of urine drug testing in the 1980s was made possible by technological improvements in testing. In the 1960s and 1970s, the screening method of choice was thin layer chromatography (TLC). TLC is inexpensive, relatively quick, and permits the simultaneous detection of many substances in a single test run. However, it requires a skilled analyst to read and is not easily adapted to mass screening programmes. In the late 1970s, radio-immune assays (RIA) and enzyme-multiplied immunoassays (EMIT) began to appear (Ackerman, 1991). These immunoassays were more easily automated allowing specimens to be screened at a lower cost that was possible with TLC. The first equipment enabled a technician to double the number of tests performed in a day (Catlin, 1973). Today’s more sophisticated equipment can process 4,000-7,000 urine samples per hour, reducing the costs for immunoassay substantially. The availability of this technology allowed the Department of Defense to plan for the rapid expansion of its testing programme (Ackerman, 1991).
2.4 Federal Initiative

In 1986, the United States Federal Government began full scale efforts to advocate urine drug testing in the workplace. In the spring of 1986, the President’s Commission on Organized Crime released its report on America’s habit: drug abuse, drug trafficking and organized crime. After outlining the relation between organized crime and illegal drug use, the commission turned towards solutions. Since attempts to limit the supply of drugs had failed, the commission advocated a series of measures to decrease demand. In particular, it called upon the Federal Government to "provide an example of the unacceptability of drug use. The President should direct heads of all federal agencies to formulate immediately clear policy statements with implementing guidelines, including suitable drug testing, expressing the utter unacceptability of drug use by federal employees" (President’s Commission on Organized Crime, 1986). On September 15, 1986, President Ronald Reagan issued the Executive Order 12564 on the Drug Free Federal Workplace. President Reagan stated that drugs were causing billions of dollars of lost productivity each year. In particular, he stated that federal employees using illegal drugs were less productive, less reliable, and prone to absenteeism. Moreover, he asserted that "the profits from illegal drugs provide the single greatest source of income for organized crime, fuels for violent street crime, and otherwise contribute to the breakdown of our society." He then called on all federal employees to refrain from using illegal drugs and mandated each executive agency to establish a programme to "test for the use of illegal drugs by employees in sensitive positions" (Reagan, 1986). Federal agencies moved quickly to set up drug screening programmes.

In January 1987, a Conrail train crashed in Maryland killing 16 passengers, injuring 174 and causing millions of dollars in property damage. The urine specimens from both the Conrail engineer and brakeman were positive for marijuana. On 21 January 1987, the U.S. Department of Transportation proposed rigorous drug testing programmes requiring pre-employment, post-accident and random testing of airline pilots, railroad workers, air traffic controllers and other employees in safety related positions (Walsh, 1991).

2.5 Judicial Challenges

The move toward drug testing in the federal workplace was challenged by several organizations. Both the American Civil Liberties Union and a variety of workers’ organizations raised concerns about drug tests as invasions of employee privacy. From 1987 to 1991, the United States Department of Justice spent US$725,000 defending drug testing related litigation (United States General Accounting Office, 1992). Two of these cases reached the Unites States Supreme Court where they were decided on March 21, 1989. In one case, the National Treasurer’s Employees Union challenged the U.S. Customs Services requirement for drug screening of certain customs employees. In the other, railway workers’ organizations sued to enjoin regulations promulgated by the Federal Railroad Administration which governed the drug and alcohol testing of railway employees. In both cases, the court upheld the legality of the government’s drug screening programme. In both cases, the court balanced the invasion of employees privacy against "other compelling government interest."
In the National Treasury Employee's Union (No. 86-1879), the court upheld the constitutionality of the programme by a 5 to 4 majority, arguing that drug-using customs officers would be vulnerable to corruption and blackmail, and might have unsound judgement. The dissenters replied that there was no incident cited in which any of these adverse outcomes had occurred: no example of bribe-taking, improper handling of a firearm or the compromise of classified information associated with drug use. In Skinner v. Railroad Labor Executive's Association (87-1555), the Supreme Court upheld by a vote of 7 to 2 the Federal Railroad Administration regulations. The majority depended heavily on the "surpassing safety interests served by toxicological tests in this context." The majority in the safety related railroad case (7-2) was larger than in the law enforcement driven customs case (5-4), suggesting that the court found the safety arguments more compelling.

Until very recently, drug testing in the workplace in the United States has been primarily limited to illegal drugs. However, recent developments suggest that there will be increasing testing for alcohol as well. Again, the new initiative in testing arose from a much publicized accident, the wreck of the Exxon Valdez, and the widespread concern for the role that alcohol use played in this incident. The Omnibus Transportation Employee Testing Act of 1991 mandates pre-employment, random, reasonable suspicion and post-accident testing for alcohol as well as for controlled substances. It requires for the Secretary of Transportation to design and implement a pilot programme for random testing of operators of commercial motor vehicles for alcohol as well as controlled substances.

2.6 The drug testing industry

The increasing use of drug tests in the American workplace has led to the emergence of a large drug testing industry. It was recently estimated that the manufacture of equipment and chemicals used in drug testing is a US$300 million industry (Skrzycki, 1990). But, the drug testing industry extends beyond the manufacturers of the equipment and chemicals. As this industry has grown, so have the number of people and organizations with a stake in workplace drug testing (Zimmer, 1992). A small number of large pharmaceutical companies market most of the chemicals and equipment to the drug testing laboratories, as well as selling directly to firms doing on-site testing. The laboratories which carry-out the testing take in hundreds of millions of dollars a year (Freudenheim, 1990). In addition, there are services necessary to keep the laboratories going, such as continuing medical education courses offered by the American Association of Analytical Chemists. An entire group of medical review officers (MROs) has arisen to review the results of the tests. They have recently formed their own MRO association which sponsors continuing medical education courses and certification examinations. Currently, over 500 MROs have been certified (MRO, 1993). In addition, the American College of Occupational and Environmental Medicine has been offering similar courses and examinations. In implementing the drug testing programme, private industry has often called upon consulting firms to advise them on how to comply with the law. Some of the best known consultants to industry were previous officials who were active in anti-drug activities. Because many employers refer first time positive employees to employee assistance programmes, increased drug testing has also increased referrals to privately owned substance abuse treatment clinics. These clinics increased in number and in volume of admissions during the decade of the 1980s (New York Times, October 2, 1989).
In addition to all these organizations with a stake in workplace drug screening, the National Institute on Drug Abuse has played a large role in expanding this programme. NIDA has sponsored a series of national conferences on the topic, has provided a toll free HELP line to assist private employers designing anti-drug programmes, and has published a wide variety of monographs and booklets supporting workplace drug screening (Walsh, 1991; Zimmer, 1992). It is important to understand the size of the drug testing industry, the variety of organizations that have a stake in drug testing, and the large number of consultants and experts who benefit financially from drug testing. All these factors must be kept clearly in mind when reviewing the drug testing literature and formulating policy.

3. RATIONALE FOR DRUG SCREENING IN THE WORKPLACE

3.1 Safety

Safety concerns have played a crucial role in the development of workplace drug testing in the United States. As noted above, several of the main advances in workplace drug testing took place shortly after, and in response to, well publicized accidents in which drugs or alcohol were implicated. The plane crash on the Nimitz, the train crash in Chase, Maryland and the wreck of the Exxon Valdes are just three examples. These accidents have had a great impact on public policy because they loom large in the minds of citizens.

Workplace drug testing always involves a trade-off: workers relinquish part of their privacy and submit to invasive tests in return for some benefits. The benefits which weigh most heavily in the public mind are safety benefits, a fact recognized early on by the supporters of workplace drug testing. In 1986, Bensinger (Bensinger, 1986) argued "the principal concern to industry must be the health and safety of its employees." Similarly, safety arguments were weighed most heavily by the Supreme Court in its first workplace drug testing case, Skinner v. Railway Labor Executives Association.

Early advocates of workplace drug testing stated that drug abusing employees had three to four times more accidents at work (Establishing a drug free workplace, Federal Personnel Manual, 1986; Bensinger, 1982). In addition, they have asserted that drug abusers have five times more compensable injuries (Quayle, 1983). Similarly, they have stated that 40 per cent of industrial fatalities and 47 per cent of industrial injuries can be traced to alcohol abuse (Quayle, 1983).

Although none of these early claims were backed by substantive empirical evidence, they appeared plausible. It is well known that the use of alcohol and other drugs can impair motor coordination and perceptual abilities. Thus, the argument that the elimination of drugs in the workplace will reduce injury rates is, on surface, plausible. Moreover, people so value health and safety that many are willing to tolerate a certain invasion of privacy in order to protect themselves and others from injury. Because of the importance of these safety arguments, both in the popular mind, in the mind of policy-makers, and in the deliberations of the U.S. Supreme Court, we will review at length the evidence on the association between occupational injuries, alcohol and other drug use in the workplace in Section 6.
3.2 Productivity

A second justification of workplace drug screening is to increase productivity in the workplace by minimizing absenteeism, turnover, and other poor work performances. While these arguments are less convincing to the general public and play a minor role in the legal defense of drug testing, they appear to loom large in the business community.

In 1983, while a U.S. Senator, Dan Quayle made this argument at length (Quayle, 1983). He pointed out that the rate of growth of productivity in the U.S. had decreased dramatically since 1977. After listing nine potential legal and regulatory policies which might be related to productivity, he turned to alcoholism and drug abuse and suggested that reduction of their negative impact could most easily increase productivity in the workplace. Framing the argument in terms of cost to productivity, Quayle stated that lost productivity due to alcohol and drug abuse amounted to US$30.1 billion a year. He went on to argue that "employees with a drinking or drug problem are absent 16 times more than the average employee." "These impaired workers function in slightly more than half their normal capacity" (Quayle, 1983).

These arguments have been used extensively as a rationale for pre-employment drug screening. In Section 7, we will look at some of the evidence relating absenteeism and turnover to drug and alcohol use.

3.3 Reduction of drug use throughout society

A third goal of workplace drug screening is to reduce the widespread use of illicit drugs in society. This was most clearly stated in the President's Commission on Organized Crime's Report (1986) which drew attention to the need to reduce demand for illicit drugs as part of the "war on drugs." Workplace drug screening was considered a tool in demand reduction. This concern continues to be a major aspect of U.S. Federal Drug Policy. The manual, Building a Drug Free Workforce, asserts that "because 70 per cent of all drug users are employed, the workplace may be the most strategic point in society from which to combat the scourge of drugs" (Office of National Drug Control Policy, 1990).

As noted in Section 2, illegal drug use in the United States has declined in recent years. It is difficult to assess what role worksite drug screening has played in this process. Although workplace drug screening may have accelerated this trend, it appears that drug use was declining before the widespread introduction of workplace drug testing.

3.4 Legislation and regulation

Finally, many employers adopt workplace drug screening programmes because they are mandated to do so. In the U.S., such regulations affect the transportation industry, the nuclear industry, and the federal government. In these industries, employers must screen applicants for certain positions as well as some categories of employees irrespective of the utility of such screening in improving safety or productivity. Through detailed government regulations, screening in these regulated industries plays a large role in setting the technical standards for the drug testing industry.
4. EMPLOYER DRUG TESTING PROGRAMMES: PRACTICE AND ATTITUDES IN THE UNITED STATES

Since most of the experience with workplace drug testing has been in the United States, it is worthwhile summarizing what we know about the practices and attitudes there. Relatively little national information is available concerning private sector efforts to deal with drug abuse in the United States. Although privately financed surveys have been conducted, they suffer from methodological problems, usually focusing on relatively small segments of the private sector and using samples which are not representative of employers as a whole (U.S. General Accounting Office, 1988). There was, however one comprehensive, scientifically conducted survey carried out by the Bureau of Labor Statistics (BLS) in the summer of 1988.

4.1 Practices

In 1988, the BLS survey showed that 3 per cent of non-agricultural establishments in the United States had drug testing programmes; these establishments employed 20 per cent of the non-agricultural workforce; a follow-up survey in 1990 (Hayghe, 1991) showed no statistically significant change in the percentage of establishments with drug-testing programmes (4.0 per cent), but did note an increase in the percentage of large employers testing. Of all establishments with 250 or more employees, 32 per cent tested in 1988 compared with 46 per cent in 1990.

The 1988 BLS study was designed to estimate the number of private, non-agricultural establishments with drug testing programmes by employment size class, major industry division, and multi-state geographic region (Bureau of Labor Statistics, 1989). The survey was a one time probability sample survey of 7,502 private non-agricultural establishments in the U.S. with one or more employees in the first quarter of 1987. It was based on a sampling frame constructed from the 1987 Unemployment Insurance Address File containing approximately 4.5 million establishments and accounting for about 85 million employees. The establishments were stratified into 400 sample strata within five geographic regions, 10 standard industrial classification (SIC) groupings, and 8 employment size classes. Response rates for the drug testing questions were very high, ranging from 84.5 per cent to 92.4 per cent. In sum, this survey provides the most scientifically collected and analyzed data on the scope and nature of workplace drug testing in the U.S.

The survey clearly demonstrated that the most important determinant of the incidence of drug testing was the establishment size as measured by the number of employees in the establishment. The larger establishments were more likely to have drug testing programmes than smaller ones (see Figure 1, page 26). Thus, among the nation's largest establishments with more than a thousand employees each, 43 per cent had drug testing programmes. In contrast, among the smallest establishments with fewer than 50 employees, only 2 per cent had drug testing programmes. Since small workplaces make up the overwhelming majority of a nation's businesses, only 3 per cent of establishments overall had drug testing programmes.

There were also differences in rates of drug testing by industry, but these were not as marked as differences by size or establishment (see Figure 2, page 27). The rates of drug testing were lowest in retail trade (0.7 per cent), service industries (1.4 per cent) and construction (2.3 per cent); they were highest in mining (21.6 per cent), communication and public utilities (17.6 per cent) and transportation (14.9 per cent). In part, some of these differences may have been accounted for by difference in size of establishment.
Differences between geographic regions were minimal with the proportion of companies with testing programmes ranging from 2 per cent in the Northeast to around 4 per cent in the south and Midwest. Of the establishments with testing programmes, about 85 per cent tested job applicants; 64 per cent tested current employees.

In private companies, relatively few current employees were actually tested for drugs. In 1987, in firms with testing programmes, just under a million workers were tested, about 1 per cent of all the eligible workers. Of the employees tested, about 9 per cent were positive for some illicit drug. Of the 3.9 million applicants who were tested, 12 per cent were positive for drug use. The percentage of employees testing positive varied from 3 per cent in service industries to 20 per cent in wholesale trade. Among job applicants, the positive rate varied from 6 per cent for the communications and public utilities to 24 per cent in the retail trades.

In 1990, the Bureau of Labor Statistics conducted a follow-up survey of a sample of 749 of the establishments that had participated in the 1988 survey (Hayghe, 1991). Overall, the survey found no statistically significant change in the incidence of drug testing programmes, 3 per cent in 1988 to 4 per cent in 1990. While many larger firms adopted drug testing between 1988 and 1990, fully one-third of the establishments with drug testing programmes in 1988 had discontinued them by 1990. Most establishments which had discontinued drug screening programmes were small businesses.

Although no equivalent to the BLS survey is available for other countries, in 1990 the International Labour Office (ILO) did carry out a study (ILO, 1991) of 53 large enterprises with greater than 1,000 employees in seven countries: Canada, Germany, the Netherlands, Norway, Sweden, the United Kingdom, and the United States. Since the ILO study was not based on a random sample, results cannot be generalized validly to all companies in these seven countries. However, discussions among the collaborators from the seven countries suggested that drug testing was an important component of workplace drug and alcohol programmes only in the United States. It was suggested that multi-national corporations might be expected to introduce drug testing in their facilities outside the United States.

4.2 Attitudes

A survey sponsored by the Conference Board, an industry sponsored group, (Axel, 1990) provides some insight into employer attitudes towards urine drug testing. However, in interpreting the results of this survey, one must keep in mind that only 26 per cent of the 2,675 questionnaires mailed out to senior human resource officers in large American companies were returned. This contrasts markedly with the return rate of 85 per cent in the Bureau of Labor Statistics Survey described above. As might be expected, the attitudes of executives of firms with drug testing programmes differed from those in firms without such programmes. In firms which are not testing, fully 63 per cent of their executives felt that their primary substance abuse problem was alcohol. By comparison, in firms that did have a drug testing programme, only 25 per cent of the executives felt that alcohol was the primary substance abuse problem. Among both groups, there was agreement that illegal drugs were more of a problem now than five years before. Both groups also agreed that alcohol, although still a problem, was no worse than it had been five years before.
Most of the companies which were drug testing had written substance abuse policies that had been carefully crafted. On the average, executives from at least four functional areas within the corporation were involved in the preparation of the substance abuse policies. Ninety-four per cent of the time, policies were written with the involvement of human relations staff. Three quarters of the time, the legal staff was involved. About half the time, the Chief Executive Officer (CEO), medical staff, labour relations staff or employee assistance programme staff were involved. In only one-seventh of the cases, were the union involved in formulation of the policy.

Executives in companies that implemented urine drug testing programmes felt that the most compelling evidence for doing so included: evidence of drugs in the workplace, a sense that drug testing was an early detection procedure, concern for legal liability for the actions of drug impaired employees, evidence of drugs in the community, and evidence that drugs were costing the company money. The executives at those companies that did not have a drug testing programme cited the threat of legal action challenging testing as the most important deterrent. Other reasons for not testing included concern with the accuracy of the test, drug testing's inability to measure impairment, and potentially negative effects on employee relations. Union opposition was reported as "not at all important" by two-thirds of the responding firms, probably a reflection of the absence of organized labour at many non-testing firms. In the financial services industry, the incompatibility of drug testing with the corporate culture and philosophy was perceived as a stumbling block.

Of the firms that were drug testing, 12 per cent reported that their programmes had been challenged in the courts. Twenty-three per cent of the programmes had been challenged by unions and brought to arbitration. In 20 per cent of the companies testing, employee resentment was a concern as was problems with cheating in the testing process.

The Conference Board Report included the following warning:

Some corporate executives, however, tempered their observations with cautionary notes. Several firms, for example, advise companies to first take stock of their own unique work conditions, business needs, and mode of operation. "A company should not start a programme just because 'everyone else is doing it'" counsels the human resources manager in a St. Louis corporation. Nor should companies overemphasize the benefits of drug testing. Cautions an Atlanta manufacturer: "Rather than being swept along by the media, companies should carefully evaluate their objectives and culture before taking steps. Education and employee assistance are far more powerful than drug testing." Going even further, an aircraft manufacturer states: "Drug testing is a very limited deterrent. A value system that does not tolerate substance abuse and a capable EAP are the only means to deal with (substance abuse) issues." And a down-to-earth reminder from the corporate medical director in a mid-western consumer goods firm: "Drug testing is not the solution to drug problems. It is only a piece of technology that supplies information for making intelligent decisions (Axel, 1990)."
5. THE EFFECTIVENESS OF WORKPLACE DRUG SCREENING IN REDUCING DRUG USAGE IN THE WORKFORCE

Workplace drug screening aims to reduce injuries, and increase work productivity by reducing drug usage among the workforce. However, there are few data showing the effects of workplace drug screening on drug prevalence in the workforce. Furthermore, obtaining scientifically valid data is quite difficult. One way to obtain such data would be a randomized controlled study by a large corporation. In such a study, similar plants would be randomized to either a drug screening programme or no such programme and levels of drug use among the workforce in the two plants would need to be monitored subsequently. This literature review revealed no such studies. In the absence of a randomized, controlled study, we are forced to rely upon historical controls to evaluate the efficacy of drug screening in reducing drug usage. This is problematic, especially over the last decade when, as noted above, there has been significant decrease in drug usage. Studies showing a decrease in drug usage after the institution of a drug programme may only be showing the effect of decreasing drug usage in society at large rather than the effect of the programme. In addition, such studies are limited by difficulty in obtaining accurate data on prevalence of drug use in working populations. Survey data is subject to reporting bias if the employee is not confident that confidentiality will be respected. Urine drug screens are subject to the increasing sophistication of workers in avoiding submitting a positive urine (Hoffman, 1987).

Although the experience of the U.S. military demonstrates that, in certain restricted circumstances, workplace drug screening can have an impact on the prevalence of drug use in the workforce, this experience cannot be generalized to the civilian workforce. Over the course of the 1980s, the U.S. military carried out one of the most rigorous employer anti-drug policies (Mulloy, 1991). This policy has included pre-enlistment urine drug screens, as well as random drug screens on all servicemen. The random drug screens have averaged more than one per serviceman per year, with the goal in the Navy being three per serviceman per year. For example, in 1986, the military undertook about 2,900,000 urine drug screens at a total cost of US$52,395,000 (Mulloy, 1991). The effects of this rigorous programme can be evaluated by following the data from the worldwide surveys of substance abuse and health behaviours among military personnel which were administered for the Department of Defense by the Research Triangle Institute in 1980, 1982, 1985 and 1988 (Burt, 1980; Bray, 1983; Bray, 1986; Bray, 1989; Bray, 1990). The sampling frame for these well-designed studies consisted of all U.S. active duty military personnel stationed across the world except recruits, service academy students and persons absent without leave. The probability sample was selected for the survey using a deeply stratified, two-stage design. The first stage sampling units were major military institutions stratified by service and world region; the second stage sampling units were individuals located at installations stratified by military pay grade. The response rate for eligible participants was 81 per cent. Drug and alcohol use were measured using a confidential questionnaire. Drug use was measured during the past 12 months and use of any drugs during the past 30 days. Using this last measure, drug use within the U.S. Armed Forces decreased over five-fold from 1980 to 1988: of all servicemen, the per centage having used drugs within the last 30 days was 27.6 per cent in 1980; 19.0 per cent in 1982; 8.9 per cent in 1985; and 4.8 per cent in 1990. These results persisted when rates were standardized to account for changes in age, education and marital status in the military over the decade of the 1980s (Bray, 1989). In part, these changes reflect similar changes occurring in the civilian labour force. However, careful comparisons of the rate of change among military personnel and civilians, suggest that the rate of change of drug use was greater among military personnel than among civilians (Bray, 1990).
In reviewing these data, one must keep in mind the rigour of military drug testing programmes. Throughout most of this decade, urine drug screens were monitored by direct observation, which is not acceptable in the civilian labour force. The programme involved frequent random screenings. Most civilian drug screening programmes do not entail random screening except in selected industries. Even in those industries, there is much pressure from the industry to cut down on the frequency of the screenings as a cost containment measure. Thus, one cannot generalize from the military experience to the civilian labour force. Specifically, the military experience provides little evidence of the capability of pre-employment drug screening alone to lower the prevalence of drug use among the civilian workforce.

Thus, we still do not know whether drug testing in the civilian workforce is effective in reducing drug usage, and if so, by how much. A randomized, controlled study would help answer this question.

6. DRUGS, ALCOHOL AND OCCUPATIONAL INJURY

To evaluate the possible benefits of workplace drug and alcohol screening, we need to have data on the adverse employment outcomes associated with drug and alcohol use. Of these adverse outcomes, the most important are occupational injuries or injuries to the public, both in the minds of the public and the U.S. judicial system. In reviewing the literature on the relation between drug and alcohol use and occupational injury, two related questions must be addressed. First, what proportion of occupational injuries are associated with drug or alcohol use? Second, how strong is the association between substance use and injury. The first question is best addressed through medical examiner's studies of fatal occupational injuries and emergency-room based population studies. The second question is better approached by evaluating industry-wide studies and population-based survey data.

6.1 Fatal occupational injuries and alcohol

In the eight series of fatal occupational injuries summarized in Table 1, about 10 per cent of the cases had alcohol detected in their blood. If one considers only those cases with blood alcohol levels of greater than or equal to 0.08 per cent, then the percentage of alcohol related work injuries decreases to less than 7.3 per cent in all but one study. That study, (Berkelman, 1985) in Fulton County, Georgia, showed 22 per cent of the fatally injured workers had blood alcohol levels greater than 0.1 per cent. However, it was based upon only 23 cases. Thus, alcohol plays a relatively restricted role in fatal occupational injuries, especially when compared with other types of injuries such as motor vehicle crashes in which about 40 per cent of all fatalities involve drivers with blood alcohol levels of 0.1 per cent or higher (Baker, 1992) or drownings, where 40 to 50 per cent of the fatalities are associated with high blood alcohol levels (Smith, 1988).

6.2 Non-fatal occupational injuries and alcohol

Only one American study (Wechsler, 1969) provides data on the proportion of occupational injuries associated with alcohol-related impairment. That study looked at alcohol levels, as measured by a breathalyzer, among a sample
of 5,622 injury patients seen in the Massachusetts General Hospital Emergency Room over a six month period in 1966-1967. Of the 969 patients who were seen for non-transport related occupational injuries, 4.9 per cent had breathalyzer levels of 0.05 per cent or greater. Another 10.6 per cent had levels between 0.01 per cent and 0.04 per cent. Thus, the elimination of all alcohol impairment on the job would only reduce the number of occupational injuries by about 5 per cent. By comparison, 17.1 per cent of the transportation related injuries were associated with alcohol levels of 0.05 per cent or greater; as were 11.3 per cent of the home injuries, 38.8 per cent of the injuries related to fights or assaults, and 13.2 per cent of all other injuries.

A more recent French study (Papoz, 1986) looked at a sample of 4,796 injury patients who were treated in the emergency units of 21 French hospitals in 1982 and 1983. Of the 882 men treated for non-transport work-related injuries, 8.3 per cent had blood alcohol levels above 0.08 per cent; of the 111 women treated, 0.9 per cent had blood alcohol levels above 0.08 per cent. Thus, the elimination of all alcohol impairment on the job would only reduce the number of occupational injuries by about 7.5 per cent. By comparison, among men, 30.9 per cent of the motor vehicle injuries were associated with alcohol levels of 0.08 per cent or greater; as were 25.0 per cent of the home injuries and 56.4 per cent of the injuries related to fights.

Similarly, a survey of a nationally representative sample of hospital emergency rooms (Trent, 1991) showed that non-work related injuries were seven times as likely to be associated with alcohol as work-related injuries. However, this study was based primarily upon reports of alcohol intoxication in medical charts rather than on systematic alcohol levels on all patients. Thus, this study underestimates the incidence of alcohol impairment in injury victims by about two orders of magnitude and one cannot rule out the possibility of differential reporting among different types of injuries.

This evidence suggests that acute alcohol impairment is present in 5 to 10 per cent of occupational injuries. Thus, it is less of a problem in relation to occupational injuries than it is in relation to motor vehicle crashes and intentional injuries. However, acute alcohol impairment is not the only way in which alcohol may be related to occupational injury. It is possible that alcoholics may have neurologic impairments which put them at risk for occupational injury even when sober. Furthermore, it is possible that employees suffering from hangovers after drinking the day before could be at risk for occupational injuries. Nine studies have attempted to address these issues with varied results (see Table 2, page 21). Many of these studies suffer from serious methodological problems because of the way the cohort was chosen, because of the definition of the high risk group and because of the way outcomes were measured. Several studies (Beaumont, 1987; Observer, 1959; Trice, 1965) reported on "problem drinkers" as defined by either company officials, or company medical personnel. By using only this small group of "problem drinkers" so identified, these studies are open to serious selection bias. For example, it is quite likely that company officials or medical personnel became aware of drinking problems of their employees because of work related injuries. Such selection bias would increase the association between "problem drinkers" and occupational injuries.

A recent study (Webb, 1992) avoids this problem with selection bias by defining the high risk populations using a questionnaire administered prospectively to all employees. This study used three separate definitions of high risk workers: problem drinkers, as defined by the Mortimer Filkins Test; heavy alcohol consumption, as defined by a seven-day drinking diary; and binge
drinking, as defined by eight or more drinks on more than one occasion. Of these three high-risk groups, only the problem drinkers showed a statistically significant association with occupational injuries. The odds ratio, a measure of the relative risk, was 2.58. However, there was no statistically significant association between average alcohol consumption over a seven day diary or a history of binge drinking with occupational injuries.

Other studies have shown similarly mixed results. A study of British municipal workers (Beaumont, 1987) showed no difference in the percentage of workers with reportable injuries or in the number of lost work days caused by occupational injuries when comparing "problem drinkers" with control workers. Similarly, a case control study of hand injuries among Maryland municipal workers (Hertz, 1980) showed no elevated risk of injury associated with drinking over the last three months or drinking within 24 hours preceding injury. However, this study was based on self report data of alcohol use and may suffer from reporting bias because injured employees may have been reluctant to report their alcohol use even when guaranteed confidentiality.

An anonymous telephone survey of New England workers (Hingson, 1985) found no association between occupational injury and a history of drinking at work. It did, however, find the association between occupational injury and those workers who drank five or more drinks per day, odds ratio 2.0 (1.0, 4.1).

A case control study of Dutch shipyard workers (Moll van Charante, 1990) found that any regular alcohol consumption was associated with occupational injuries. The odds ratio, a measure of the relative risk, was 1.65, even after controlling for a variety of other potential predictors of injury, such as noise at work, hearing loss and working on the dock.

After reviewing this group of studies, we can conclude the following:

- Acute alcohol impairment is present in about ten per cent of fatal occupational injuries.
- Acute alcohol impairment is present in about five per cent of non-transport, non-fatal, work-related injuries.
- A history of alcohol abuse may be weakly associated with occupational injuries (odds ratios ranging from 1.0 up to 2.58).
- The wide variety of methodological difficulties in the various studies of the association of a history of alcohol abuse and occupational injuries should make the reader cautious in drawing conclusions from this literature.

6.3 Fatal occupational injuries and drug use

Medical examiner data is not as useful in assessing the role of drugs in occupational fatalities as it is for alcohol. In the case of alcohol, identification of blood level greater than 0.08 per cent suggests strong evidence of impairment at the time of death implying that alcohol contributed to the causation of the fatality. For other drugs, such as marijuana and cocaine, the presence of blood or urine metabolites at death provides little evidence relating to impairment. Thus, for illicit drugs, one needs a control
group to compare with the fatally injured workers. If the percentage of fatally-injured workers with drugs in their urine and blood was substantially greater than that of the control group one could argue for an association of drug use and fatal occupational injuries. Unfortunately, the medical examiner's data summarized in Table 1 does not come with appropriate controls. Most of the studies did not even provide results of toxicological screens on the patients. The study of Houston workers (Lewis, 1989) had such low rates of drug positives as to raise concerns about the completeness of the toxicological studies. The Pittsburgh study (Parkinson, 1986) detected no illicit drugs in any of the fatally injured workers, but the cohort was too small to generate stable rates. In Alberta, Canada, a larger study (Alleyne, 1991) reviewed 459 fatalities, but it detected no illicit drugs except for marijuana which was present in 8.5 per cent of workers tested between 1983 and 1986. These numbers might well be consistent with the prevalence of drug usage on injured Canadian workers at that time. In sum, these three mortality studies provided no evidence for an association between fatal occupational injuries and drug use, but they do not rule out the possibility of such association either.

6.4 Non-fatal occupational injuries and drug use

Only two studies have carefully examined the relationship between non-fatal occupational injuries and drug usage, both among postal workers in the United States. In Boston, 2,537 new postal employees were followed longitudinally (Zwerling, 1990). In this prospective study, the employees were tested for marijuana, cocaine, opiates, phencyclidine, barbiturates and amphetamines in a double blinded fashion. That is neither the postal service nor the employees knew the results of the drug test. They were then followed for an average of one year. Those whose urines were positive for marijuana were found to have a relative risk of injuries of occupational injuries of 1.85 and a relative risk of accidents of 1.55. Those who were positive for cocaine were found to have a relative risk for occupational injuries of 1.85 and a relative risk of accidents of 1.59. (All these results were statistically significant except the last which had a 95% confidence interval of 0.95, 2.67.)

In addition, the United States Postal Service carried out a multi-site study modeled on the Boston study (Normand, 1990). The multi-site study was a blind prospective study of 4,396 new postal employees in 21 sites nationwide. Although the study does not present details of their analysis, it found no increased risk for injuries or accidents. An update of this longitudinal study (Normand, 1990A) found no evidence of an association between injuries and accidents and marijuana and cocaine use. The conflicting results of the multisite and Boston studies could both be consistent with a weak association between injuries and accidents and cocaine and marijuana use in the Postal Service.

6.5 Alcohol, drugs and occupational injuries in transportation

We can obtain a clearer view of the association between illicit drugs and alcohol and fatal injuries in the high-risk industry of heavy truck drivers by comparing two separate studies. For a year, beginning October 1, 1987, the National Transportation Safety Board carried out a careful study of all fatal to the driver heavy truck accidents in eight states chosen to give a representative sample of all trucking operations in the United States (National Transportation Safety Board, 1990). This study consisted of 185 case drivers for which toxicological testing was obtained for 168 (91 per cent) of them.
Fortuitously, another careful study (Lund, 1988) gives estimates of drug and alcohol use among representative non-injured heavy truck drivers. That study was carried out during December of 1986 at a truck weighing station in Brownsville, Tennessee. A total of 349 representative drivers were asked to participate. Of these, 317 (88 per cent) consented to participate in a health-related study and were paid US$30 each. They each provided anonymous urine and blood samples for toxicological analysis.

Table 3 (page 24) compares the drug and alcohol use among the fatally-injured drivers and uninjured controls. One-eighth of the fatally-injured drivers had alcohol detected as compared to one per cent of the controls. The contrast is more marked when one realizes that the average blood alcohol concentration for the fatally injured drivers was 0.15 per cent whereas the average blood alcohol concentration for the controls was 0.02 per cent. The data suggest that alcohol impairment plays a major role in one-eighth of fatal-to-the-driver heavy truck accidents. For marijuana, the per centage of fatally-injured drivers positive is similar to the per centage of uninjured controls that are positive, 12.8 and 14.8 per cent respectively. These data suggest that there is no association between marijuana positive urines and fatal-to-the-driver heavy truck crashes. For cocaine and amphetamines, about eight per cent of fatally-injured drivers were positive as opposed to 2.2 per cent of the uninjured controls. In reviewing these data, we must keep in mind that we have not been able to control for demographic differences between the two populations. Moreover, the controls were examined one year before the fatally-injured drivers, so that it is possible that the results can be partially explained by temporal or geographical variations.

The results of the urine drug screen results collected by the Federal Aviation Administration for year 1991 give some sense of the role of drug use in non-fatal accidents in that industry. Table 4 (page 25) compares the per centage of urines positive for drugs in the random testing of almost 170,000 aviation employees with the per centage of urine positive for drugs among employees tested after accidents. The overwhelming majority of these post-accident tests did not involve fatalities. In both cases, about three-quarters of one per cent of the urines were positive. Again, we must interpret these results cautiously because of lack of adjustment for demographic differences between the two groups or for the nature of the job assignments of the various employees. Keeping these caveats in mind, we find that the data provide no evidence of an association between drug use and accidents in the aviation industry, but they cannot exclude the possibility of such an association.

In summary, a review of the data suggests that alcohol impairment is present in about 10 per cent of occupational fatalities. The data are especially strong among heavy truck drivers. Those with a clinical history of alcohol abuse may also have a slightly elevated relative risk of non-fatal occupational injuries compared to those without such a history. However, the data here are not entirely consistent. The relationship between fatal injuries and illicit drug use is more difficult to define. Medical examiner studies are not as useful because positive urine for drugs is not necessarily associated with impairment. In the heavy trucking industry, the evidence suggested that those with marijuana positive urines were not at increased risk of fatal injuries while those with urines positive for amphetamines and cocaine may have been. There was very little evidence concerning the association of drug use and non-fatal injuries. The association has been studied only in one industry: the United States Postal Service. There, one study showed a weakly elevated relative risk for injury among cocaine and marijuana positive employees, but a second showed no increase. A review of Federal Aviation Administration data suggests that there was no association between accidents and positive urine drug screens. However, those data are subject to methodological concerns.
7. DRUG TESTING AND OTHER ADVERSE EMPLOYMENT OUTCOMES

Although safety concerns have loomed largest in discussions of workplace drug screening, it has also been argued that drug testing could increase productivity (Quayle, 1983). It was suggested that this could be accomplished by reducing absenteeism, containing medical costs, restricting disciplinary procedures, and containing employee assistance programme costs. Both the Boston and multisite postal studies show an association between increased rates of absenteeism and positive pre-employment drug screens. The initial results of the Boston postal study after 13 months of follow-up showed that those with marijuana positive urines had a 1.56 relative risk of being in the higher absenteeism groups and those with cocaine positive urines had a 2.37 per cent relative risk of being in the higher absenteeism groups compared to those with negative urines (Zwerling, 1990). The mean absenteeism rates were 7.1 per cent for the marijuana positives, 9.8 per cent for the cocaine positives and 4.0 per cent for the negatives. After 24 months of follow-up, the relative risk of being in the high absenteeism groups had decreased to 1.31 for the marijuana positive and was no longer statistically significant; for the cocaine positives, the relative risk being in the high absenteeism groups had increased to 2.65 per cent (Ryan, 1992). After two years, the mean absence rates were 9.1 per cent for the marijuana positives, 13.8 per cent for the cocaine positives and 6.0 per cent for the negatives. The multi-site postal study did not distinguish between marijuana and cocaine positive urines. However, it did find, after 8.2 months of follow-up, that those with drug positive urines averaged 4.35 per cent absenteeism as compared to those with drug negative urines who averaged 3.0 per cent absenteeism (Normand, 1990). After 3.3 years of follow-up, the multi-site postal study found that the drug positives average 11.39 per cent absenteeism as compared to the drug negatives who averaged 6.85 per cent absenteeism (Salyards, 1991).

Both postal studies also showed increased risks of disciplinary action associated with positive pre-employment drug screens. In Boston, those with marijuana positive urines had a 1.48 per cent relative risk of formal discipline compared to those with negative urines (Ryan, 1992); those with cocaine positive urines had a 1.72 per cent relative risk compared to the drug negatives. In the multi-site study, the odds ratio, a measure of relative risk, for discipline among the marijuana positives was 1.87; among the cocaine positives it was 5.52 (Salyards, 1992). The multi-site postal study provides further insight into the nature of these disciplinary infractions: 118 of the 149 drug positive drug subjects who received discipline were disciplined for poor attendance. Surprisingly, those who tested positive for drugs did not have an increased risk of discipline based on poor work performance (Salyards, 1992).

There is very limited and conflicting data concerning medical benefits used by employees who screened positive for illicit drugs. The multi-site postal study (Salyards, 1992) analyzed medical claims only for the 19 per cent of their study group who subscribed to Blue Cross/Blue Shield Insurance. They found that the median dollar amount of claims for the positives (US$486.65) was 83 per cent higher than that of the negatives (US$265.81). However, one must be concerned about the 80 per cent of their sample for which no data is provided. A study at Utah Power and Light Company (Crouch, 1989), compared employees who screened positive on a random drug test with a random sample of company employees. The annual medical expenditures per positive employee were US$504.00 as compared with medical expenditures in the control group which averaged US$719.00. However, this study included only 12 employees who had positive urines.
Finally, the multi-site postal study (Salyards, 1992) suggested that those whose pre-employment drug screens were positive are more likely to be referred to the employee assistance programme during the course of employment. For marijuana positives, the odds ratio was 1.91 per cent; for cocaine positives, it was 6.27 per cent. Twenty-nine (10.7 per cent) of the 270 marijuana positives were eventually referred to EAP. Twenty-six (28.3 per cent) of the cocaine positives were eventually referred to the EAP. It should be noted that most (54 per cent) of the overall referrals were for alcohol-related problems.

In summary, there is good evidence, at least in a single industry, that those with positive pre-employment drug screens have higher rates of absenteeism which lead to higher rates of disciplinary action. The evidence on the association between positive drug screens and medical costs is weak and conflicting.

8. COST-BENEFIT ANALYSIS

Advocates of workplace drug testing often cite the global costs of drug and alcohol abuse to society. They talk about the large number of substance abusers in the workplace and conclude by advocating workplace drug and alcohol testing as a solution to this problem. However, this quick transition from a global problem to a specific solution skips over several important steps. First, one must show that this specific solution works, i.e., that workplace drug testing can be expected to decrease adverse employment outcomes such as injuries and absenteeism. Sections 6 and 7 have reviewed the literature on this issue. Then, one must further show that the specific intervention is cost-effective—that is, that it achieves favorable outcomes without incurring disproportionate costs. This section addresses the cost-benefit data.

In 1986, an editorial in the Journal of the American Medical Association pointed out that a great deal of pre-employment drug screening was being done without "one proper cost-benefit analysis of this process in any peer review journal" (Lundberg, 1986). Since that time, two cost-benefit analysis of pre-employment drug screening have appeared in the literature (Normand, 1990; Zwerling, 1992). Before reviewing these two analysis, we must first consider some of the requisites for a convincing cost-benefit analysis (Warner, 1982; Drummond, 1987). A good cost-benefit analysis must include the following:

- A clear and accurate description of the intervention to be evaluated.
- Evidence of the intervention's effectiveness.
- A fair and comprehensive assessment of the costs and consequences of the programme.
- Adjustment of the costs and consequences according to when they occur (discounting).
- A sensitivity analysis to evaluate the effect of changing the underlying assumptions.
The first cost-benefit analysis of pre-employment drug screening was carried out by the United States Postal Service based upon their multi-site study (Normand, 1990). Assuming that the U.S. Postal Service would need to test approximately 180,000 applicants in order to hire 61,588 new employees per year and assuming that 9 per cent of them would have positive drug screens, they concluded that for each yearly cohort of new employees, the postal service would save US$52,750,000 over the 10 year average postal career. Comparing this analysis to the standard described above reveals some problems. First, the analysis assumes that the increased cost of absenteeism will continue unchanged for 10 years even though the study is based on an average follow-up of only 1.3 years. It would have been more appropriate to present the cost and benefits after a single year of employment. Second, the study does not discount the value of future savings, although economists differ as to the appropriate rate of discounting, almost all would agree that some discount percentage should be included in cost-benefit calculations (Warner, 1982, pp. 93-98). Third, the analysis assumes the cost of testing is only the US$11 laboratory fee, ignoring the costs of collection, storage and transportation of the urine and of seeking replacements for those applicants screened out by the tests. A recent report by the government accounting office (GAO, 1992) suggests that the average cost per urine drug screening by the U.S. Federal government was US$73.46. The report also acknowledges that this estimate is low because it includes only the direct costs; it does not include the costs associated with delayed hiring, and recruiting replacement workers for those screened out. Finally, the multi-site study provided no sensitivity analysis to show how changes in its underlying assumptions would affect the cost-benefit analysis. As noted, these assumptions are somewhat subjective and could vary significantly. A reanalysis illustrated the importance of sensitivity analysis by repeating the multi-site cost-benefit analysis limited to the first year of employment and using more reasonable assumptions (Zwerling, 1992). Under these new assumptions, the costs of the programme, US$8.87 million, exceeded the benefits of the programme, US$5.41 million by US$3.46 million.

A second cost-benefit analysis based upon the Boston Postal Service Study (Zwerling, 1992A) found that drug testing would save the Boston Postal Service US$163.00 per newly hired employee. But more important, the study found that these results were very sensitive to the assumptions used in the calculations. The most important assumption was the prevalence of drugs in the populations screened. For prevalences under one per cent, the programme would lose money. For prevalences above ten per cent, the programme would save money. For prevalences between one and ten per cent, the exact nature of the other cost assumptions determined whether the programme saved money or lost money.

It is likely that the prevalence of drugs in the population screened would be the driving force in other cost-benefit analyses of pre-employment drug screening. When drug use is rare, many applicants must be screened to identify a drug user. Thus, unless the costs associated with a single person's drug use are very high, the programme will lose money. Since these costs as well as the prevalence of drug use are likely to vary from industry to industry and company to company, it is important that a careful cost-benefit analysis be carried out before instituting drug screening in any specific situation. Moreover, as shown in Section 2, the prevalence of drug use can change substantially over the years. Thus, it would be prudent for a company to repeat their cost-benefit analysis periodically.

Finally, the costs and benefits described above are only those accruing to the single enterprise. They do not consider external costs (Sexton, 1988). Thus, the social costs of the invasion of privacy to obtain the urine, of the unemployment insurance paid to applicants screening positive, and of the damaged reputations of those falsely identified as positive did not enter into these calculations.
9. FUTURE TRENDS AND POLICY CONCERNS

Over the last six years, we have seen a great increase in the amount of workplace drug testing in the U.S., in large part in response to federal regulation. As described above, an entire industry has grown up around these regulations. Thus, there are strong economic interests that can be expected to continue to advocate expansion of workplace drug testing, both in the U.S. and elsewhere. On the other hand, recent data suggest that drug usage is beginning to decline. Should this continue, public support for workplace drug testing might begin to weaken. Until recently, most workplace drug screening has been focused on illicit drugs. However, the passage of the Omnibus Transportation Employee Testing Act in 1991 in the U.S. and the recent publication of proposed regulations by the Department of Transportation suggest that alcohol testing in the workplace is likely to increase in the U.S. in the years ahead.

As described in Sections 6 and 7, the empirical basis for workplace drug screening is weak. Most importantly, no strong relationship between drugs and alcohol and occupational injuries has been established. Two types of studies would be especially useful in addressing these issues. First, case-control studies looking at drug and alcohol use among injured employees and non-injured controls could well shed further light on these questions. In the U.S. transportation industry, hundreds of thousands of random and post-accident drug screens are being performed. If this was done while collecting the appropriate demographic data in a centralized fashion, it would enable one to look at the association between drug and alcohol use and accidents in that industry. Second, prospective longitudinal studies following cohorts of workers after drug testing would be very useful. The two postal studies (Zwerling, 1990; Normand, 1990) show that the efficacy of pre-employment drug screens is less than previously supposed. It would be valuable to see if these results extended to other industries. This type of study is especially important because it forms the basis for cost-benefit analyses of drug screening.

For the policy-maker, this review of the literature suggests three lessons:

- Humility in the face of sparse empirical data. We still know relatively little about the role of alcohol and drugs in the workplace. In their decision-making process, policy-makers should avail themselves of findings from existing studies paying special attention to the methodologies used.

- Attention to variation among different industries. The contradictory findings in different studies suggest that substance abuse may well play different roles in different occupational and cultural settings. One should be cautious in transposing results from one setting to another.

- The importance of the prevalence of drug use in cost-benefit analyses. Any economic analysis of workplace drug screening is likely to be greatly influenced by the prevalence of drug use in the population screened.
<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Subjects (number)</th>
<th>Years of Study</th>
<th>Alcohol</th>
<th>Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alleyne (1991)</td>
<td>Workers in Alberta, Canada (459)</td>
<td>1979-86</td>
<td>BAC&gt;0.08% - 4.3%</td>
<td>Illicit except THC 0.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&lt;0.08%&gt;0.01% - 1.6%</td>
<td>THC 8.5% (1983-86 only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&lt;0.01% - 4.8%</td>
<td></td>
</tr>
<tr>
<td>Baker (1982)</td>
<td>Workers in Maryland (148)</td>
<td>1978</td>
<td>BAC&gt;0.08% - 11%</td>
<td>No data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&lt;0.08%&gt;0.02% - 0.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&lt;0.02% - 5%</td>
<td></td>
</tr>
<tr>
<td>Berkelman (1985)</td>
<td>Workers in Fulton County, Georgia (29)</td>
<td>1981-82</td>
<td>BAC&gt;0.1% - 22%</td>
<td>No data</td>
</tr>
<tr>
<td>Copeland (1985)</td>
<td>Workers in Miami, Florida (147)</td>
<td>1979-83</td>
<td>BAC&gt;0.1%</td>
<td>Highway work 0.0% (n=9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Highway work 5.6%</td>
<td>Non-highway work 9.2% (n=65)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-highway work - 2.2%</td>
<td></td>
</tr>
<tr>
<td>Lewis (1989)</td>
<td>Workers in Harris County, TX (Houston) (208)</td>
<td>1984-85</td>
<td>BAC&gt;0.1% - 9.2%</td>
<td>THC 0.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&lt;0.1% - 4.0%</td>
<td>No other illicit drugs</td>
</tr>
<tr>
<td>Parkinson (1986)</td>
<td>Workers in Allegheny County, PA (Pittsburgh) (41)</td>
<td>1983-84</td>
<td>BAC&lt;0.045 - 7.3%</td>
<td>No drugs detected</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&gt;0.045 - 2.4%</td>
<td></td>
</tr>
<tr>
<td>Robinson (1988)</td>
<td>Workers in Allegheny County, PA (Pittsburgh) (68)</td>
<td>1979-82</td>
<td>BAC&gt;0.1 - 7.5%</td>
<td>No data</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BAC&lt;0.1% - 4.5%</td>
<td></td>
</tr>
<tr>
<td>Sniezek (1989)</td>
<td>Workers in North Carolina (1233)</td>
<td>1978-84</td>
<td>BAC&gt;0.1% - 6.5%</td>
<td>No data</td>
</tr>
<tr>
<td>Author (Year)</td>
<td>Subjects (Number)</td>
<td>Years of Study</td>
<td>Study Design</td>
<td>Alcohol Measure</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------</td>
<td>----------------</td>
<td>-------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Beaumont (1987)</td>
<td>British municipal workers (100 cases, 60 controls)</td>
<td>1978-83</td>
<td>Cohort</td>
<td>Company identified &quot;problem drinkers&quot;</td>
</tr>
<tr>
<td>Buchanan (1988)</td>
<td>Zambian copper mines (309 cases, 95 random controls)</td>
<td>1980-85</td>
<td>Case-control</td>
<td>Blood alcohol and breathalyzer</td>
</tr>
<tr>
<td>Hertz (1986)</td>
<td>Maryland municipal workers (124 cases, 124 controls)</td>
<td>1983</td>
<td>case-control</td>
<td>Self-report of alcohol use - last 3 months - last 24 hours</td>
</tr>
<tr>
<td>Hingson (1985)</td>
<td>Anonymous telephone survey of New England workers (1740)</td>
<td>1982-83</td>
<td>Random sampling - cross-sectional survey</td>
<td>Drinking at work. Average daily intake of 5+ drinks</td>
</tr>
<tr>
<td>Moll van Charante (1990)</td>
<td>Dutch shipyard workers (300 cases, 300 controls)</td>
<td>1986-87</td>
<td>Case-control</td>
<td>Any regular alcohol consumption</td>
</tr>
<tr>
<td>Observer (1959)</td>
<td>Employees of one large American company (48 cases, 96 controls)</td>
<td>Cohort</td>
<td>Company-identified problem drinkers</td>
<td>Occupational injury</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------------------------------------------</td>
<td>--------</td>
<td>-----------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Papoz (1986)</td>
<td>Injury patients in 21 French emergency units (4796)</td>
<td>1982-83</td>
<td>Cross-sectional survey</td>
<td>Blood alcohol tests</td>
</tr>
<tr>
<td>Trent (1991)</td>
<td>Survey of a nationally representative sample of U.S. hospital emergency rooms (63 hospitals)</td>
<td>1986-87</td>
<td>Nationally representative survey</td>
<td>Patient's chart or laboratory value</td>
</tr>
<tr>
<td>Trice (1965)</td>
<td>Employees of large eastern company (72 alcoholics, 204 controls)</td>
<td>1958-61</td>
<td>Cross-sectional</td>
<td>Alcoholics chosen from company medical records - controls sample from other employees</td>
</tr>
<tr>
<td>Study (Year)</td>
<td>Population</td>
<td>Year</td>
<td>Study Design</td>
<td>Measures</td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
<td>------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>Webb (1992)</td>
<td>Manufacturing workers in one plant in New South Wales, Australia (859)</td>
<td>1985-86</td>
<td>Cohort</td>
<td>Alcohol consumption (7-day diary) Problem drinkers (Mortimer-Filkens Test) Binge drinking &gt; 8 drinks on one occasion</td>
</tr>
<tr>
<td>Wechsler (1969)</td>
<td>Injury patients in a Boston emergency room (5622)</td>
<td>1966-67</td>
<td>Cross-sectional survey</td>
<td>Breathalyzer test results</td>
</tr>
</tbody>
</table>
Table 3.
Drug/Alcohol Use Among Fatally-Injured Drivers and Uninjured Controls

<table>
<thead>
<tr>
<th>Drug</th>
<th>Fatally Injured Drivers</th>
<th>Representative Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of completed tests</td>
<td>Drivers Positive</td>
</tr>
<tr>
<td>Alcohol</td>
<td>168</td>
<td>21</td>
</tr>
<tr>
<td>Marijuana</td>
<td>164</td>
<td>21</td>
</tr>
<tr>
<td>Cocaine</td>
<td>165</td>
<td>14</td>
</tr>
<tr>
<td>Meth/Amphetamine</td>
<td>164</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Number Tested</td>
<td>Number Positive</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Random Tests</td>
<td>169,240</td>
<td>1,232</td>
</tr>
<tr>
<td>Post-accident Tests</td>
<td>534</td>
<td>4</td>
</tr>
</tbody>
</table>
Figure 1 - Percent Of U.S. Non-Agricultural Firms With Drug Testing Program By Number of Employees in Firm

Number of Employees

<table>
<thead>
<tr>
<th>Number of Employees</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3.2</td>
</tr>
<tr>
<td>1-9</td>
<td>0.8</td>
</tr>
<tr>
<td>10-49</td>
<td>6.4</td>
</tr>
<tr>
<td>50-99</td>
<td>12.4</td>
</tr>
<tr>
<td>100-249</td>
<td>17.2</td>
</tr>
<tr>
<td>250-499</td>
<td>29.7</td>
</tr>
<tr>
<td>500-999</td>
<td>30.6</td>
</tr>
<tr>
<td>1000-4999</td>
<td>41.8</td>
</tr>
<tr>
<td>5000+</td>
<td>59.8</td>
</tr>
</tbody>
</table>

Summer, 1988
Figure 2 - Percent of U.S. Non-Agricultural Firms With Drug Testing By Industry

Percent

- Total: 3.2%
- Mining: 21.6%
- Construction: 2.3%
- Mfg Durable: 9.9%
- Mfg Non-Durable: 9.1%
- Transportation: 14.9%
- Communic & Pub Util: 17.6%
- Wholesale: 5.3%
- Retail: 0.7%
- Fin, Ins, Real Est: 3.2%
- Services: 1.4%

Summer, 1988
11. REFERENCES


