DRUGS AND HIGHWAY SAFETY 1980

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U.S. Department of Transportation
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Document is available to the public through
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Document is available to the public through
the National Technical Information Service
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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
DRUGS AND HIGHWAY SAFETY 1980	May 1980
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Kent B. Joscelyn, Alan C. Donelson, Ralph K. Jones, John W. McNair, and Paul A. Ruschmann	UM-HSRI-80-5

9. Performing Organization Name and Address	10. Work Unit No.
Highway Safety Research Institute The University of Michigan Huron Parkway and Baxter Road Ann Arbor, Michigan 48109	11. Contract or Grant No. DOT-HS-7-01530
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration 400 Seventh Street, S.W. Washington, D.C. 20590	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes Other reports produced under this contract: Drugs and driving: A selected bibliography. Supplement one. (DOT-HS-803-879). Drug research methodology. Volumes One, Two, Three, Four, and Five.

16. Abstract

This report presents findings of a study to describe (1) present knowledge about the relationship between drug use by drivers and highway safety, and (2) efforts to detect and prevent drug-impaired driving. Past, ongoing, and planned activities at federal, state, and local levels are identified, including research to define the nature and magnitude of the drug and driving problem and actions to reduce the incidence of drug-impaired driving.

An overview of drugs and highway safety summarizes the present state of knowledge and discusses the alcohol-highway safety experience in relation to other drugs. Studies of drug effects on measures of driving performance and surveys of drug use among drivers are then reviewed. Also reviewed are the state of the art and current applications of techniques to detect and measure drugs in body fluids of drivers. The treatment of laws relevant to drugs and driving includes a detailed comparison of state laws dealing with drug-impaired driving, their application and limitations. Enforcement, adjudication, and sanctioning practices are described. Specific examples of other countermeasure approaches, including information and education campaigns, are presented. Issues present in each of the above areas are identified and future actions to address priority needs are recommended.

17. Key Words	18. Distribution Statement
Alcohol, Marijuana, Drugs, Highway safety, Drug use, Drug effects, Drug analysis, Impaired driving laws, Countermeasures	This document is available to the public through the National Technical Information Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	250	

ACKNOWLEDGMENT

This report results from efforts involving many persons and reflects their able and welcome contributions. We thank all who assisted in its development, preparation, and production.

Special recognition is due to over 700 agencies, organizations, and individuals at federal, state, and local levels that responded to our requests for information, on which much of this report is based. Many provided extensive documentation of their activity. Some agencies, at their own expense, compiled data for our use or sent detailed project descriptions from computer files. Their willingness to cooperate evidenced a deep concern about drugs and highway safety. We are grateful for their generous and timely support.

The area of drugs and highway safety involves many disciplines. Its scope ranges from basic research pertaining to drugs and transportation, to applied research on behavioral and social aspects of drug use by drivers, to programs implemented by enforcement, health, and other agencies in the field. We were fortunate to have been assisted in the gathering of information by individuals who possessed such diverse disciplinary backgrounds. Suzanne Slater, Susan Rivkin, Dennis Powers, and Jerry Vidis participated in the design and development of data collection guides and encoding forms, made hundreds of direct contacts, and produced preliminary syntheses of their findings.

Ann C. Grimm and Kris Huber of the HSRI Library assisted in searching the literature and in accessing information retrieval systems for descriptions of federally sponsored projects related to drugs and driving.

The processing of information that flowed from these efforts was a task unto itself. Phyllis A. Gimotty, assisted by Brian G. Wolf and Thipata Chirachavala, expertly handled the computerization of vast quantities of data for subsequent analysis and interpretation. Patti A. Ferullo and Lee E. Ferris of HSRI Computing Services also participated. We greatly appreciate their contributions to this work.

In writing this report, each author was responsible for preparing drafts of chapters dealing with specific topic areas. The final text, however, reflects the efforts of all authors as each reviewed and rewrote the work of the others. Dr. Donelson served as project coordinator and concentrated on technical issues related to experimentation, epidemiology, and methodology. Messrs. McNair and Ruschmann had primary responsibility for legal issues, the review of laws pertaining to drug-impaired driving, and their application. Mr. Jones brought his understanding of past work in alcohol and highway safety to discussions of countermeasures and focused on health/legal and public information and education approaches. Mr. Joscelyn served as project director with overall responsibility for integrating the different disciplinary perspectives. The major findings, conclusions, and recommendations were jointly developed and were jointly made by all the authors.

The authors were assisted by reviewers who commented on early drafts. These included Stephen D. Benson, Ph.D., who also serves as Contract Technical Manager for this project.

Other HSRI personnel also made important contributions. The clerical staff of the Policy Analysis Division under the supervision of Jacqueline B. Royal and Janet Peters generally facilitated the process of report-making. They produced the large amounts of correspondence and other written material generated by this study. Olga S. Burn assisted in the coordination of report production and organized voluminous files of collected material. Mary Veldkamp compiled the bibliography. Jerry Vidis produced the computerized tables that appear in this report and Kathleen Jackson produced the illustrations.

This report was edited by James E. Haney. Liz Brater of Edigraphics, who edited an early draft of what is now Chapters Six and Seven, also helped in making this report more readable. Anne L. VanDerworp served as production editor. Deborah M. Dunne served as lead word processing operator and produced the report.

We recognize that this report represents far more than the efforts of the authors. We are pleased to acknowledge those named above and others too numerous to list here. We thank all who contributed.

PREFACE

This report presents the findings of a study that reviewed federal, state, and local efforts (past, ongoing, and planned) related to marijuana, other controlled substances, and highway safety. This report supported the preparation of a report to Congress by the Secretary of Transportation as requested in Section 212 of the Highway Safety Act of 1978. The study was conducted by The University of Michigan Highway Safety Research Institute (HSRI) under the sponsorship of the National Highway Traffic Safety Administration contract no. DOT-HS-7-01530, as part of a larger research program on drugs and driving.

A reader interested in the subject area will find of value additional reports prepared under this and other contracts that comprise the NHTSA research program.

Under contract no. DOT-HS-7-01530, a series of workshops were conducted to examine methodological issues in research on drugs and highway safety. The workshops addressed discrete--but interrelated—topics. The workshop reports are:

- Drug Research Methodology. Volume One. The Alcohol-Highway Safety Experience And Its Applicability To Other Drugs.
- Drug Research Methodology. Volume Two. The Identification Of Drugs Of Interest In Highway Safety.
- Drug Research Methodology. Volume Three. The Detection And Quantitation Of Drugs Of Interest In Body Fluids From Drivers.
- Drug Research Methodology. Volume Four. Epidemiology In Drugs And Highway Safety: The Study Of Drug Use Among Drivers And Its Role In Traffic Crashes.
- Drug Research Methodology. Volume Five. Experimentation In Drugs And Highway Safety: The Study Of Drug Effects On Skills Related To Driving.

Another report prepared under the HSRI project was an annotated bibliography of literature on drugs and driving and related topics:

- Joscelyn, K.B., and Donelson, A.C. 1979. Drugs And Driving: A Selected Bibliography. Supplement One. National Highway Traffic Safety Administration technical report DOT-HS-803-879.

The reports cited above developed from and extended similar work done under earlier contracts from NHTSA:

- Joscelyn, K.B., and Maickel, R.P. 1977. Drugs And Driving: A Research Review. National Highway Traffic Safety Administration technical report DOT-HS-802-189.

- Joscelyn, K.B., and Maickel, R.P. 1977. Drugs And Driving: A Selected Bibliography. National Highway Traffic Safety Administration technical report DOT-HS-802-188.

- Joscelyn, K.B., and Maickel, R.P., eds. 1977. Report On An International Symposium On Drugs And Driving. National Highway Traffic Safety Administration technical report DOT-HS-802-187.

- Joscelyn, K.B.; Jones, R.K.; Maickel, R.P.; and Donelson, A.C. 1979. Drugs And Driving: Information Needs And Research Requirements. National Highway Traffic Safety Administration technical report DOT-HS-804-774.

- Jones, R.K., and Joscelyn, K.B. 1979. Alcohol And Highway Safety 1978: A Review Of The State Of Knowledge. National Highway Traffic Safety Administration technical report DOT-HS-803-714.

- Jones, R.K., and Joscelyn, K.B. 1979. Alcohol And Highway Safety 1978: A Review Of The State Of Knowledge. Summary Volume. National Highway Traffic Safety Administration technical report DOT-HS-803-764.

- Jones, R.K.; Joscelyn, K.B.; and McNair, J.W. 1979. Designing A Health/Legal System: A Manual. The University of Michigan Highway Safety Research Institute report no. UM-HSRI-79-55.

These reports provide entry points to the literature on alcohol, other drugs, and highway safety for readers desiring general reviews as well as

information on specific topic areas. In addition, the reports can serve as sources for identifying both U.S. and foriegn literature pertinent to each reader's needs.

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CHAPTER ONE
INTRODUCTION

This is a report on marijuana, other controlled substances, and highway safety. It contains:

- a summary of activity in the area of drugs and driving (past, ongoing, and planned) at federal, state, and local levels; and
- a discussion of the findings and their implications for the future activity.

This report was prepared as part of an ongoing project that examines methodological and other issues in drugs and driving.

BACKGROUND

The University of Michigan Highway Safety Research Institute (HSRI) is examining issues related to drugs and driving under the sponsorship of the National Highway Traffic Safety Administration (NHTSA) contract DOT-HS-7-01530. The general objectives of the HSRI study, entitled Drug Research Methodology, are:

- to develop a greater understanding of the drug and driving problem on the basis of existing literature; and
- to define directions for future research.

The project focuses on approaches to solving research issues in drugs and highway safety. Specific objectives are:

- to identify problem areas that should be addressed;
- to specify workable and detailed approaches that can be implemented with current technology; and
- to list subjects that should take priority in NHTSA drug research in the foreseeable future.

To accomplish these objectives, an approach based on workshops is used. To date, five distinct but interrelated areas have been examined:

- The Identification of Drugs of Interest in Highway Safety
- The Detection and Quantitation of Drugs of Interest in Body Fluids from Drivers
- Epidemiologic Research in Drugs and Highway Safety: The Study of Drug Use Among Drivers and Its Role in Traffic Crashes
- Experimental Research In Drugs and Highway Safety: The Study of Drug Effects on Skills Related to Driving
- The Alcohol-Highway Safety Experience and its Applicability to Other Drugs

A separate task supports the workshops—the review of the literature on drugs and driving. A report produced under this contract (Joscelyn and Donelson 1979) presented an annotated bibliography of recent publications relevant to drugs and highway safety. A second bibliographic report is planned for publication in Summer 1980.

In 1978, the Surface Transportation Assistance Act of 1978 was signed into law. Title II of this Act, entitled Highway Safety Act of 1978, contained a congressional request for a report on marijuana and other drugs and highway safety from the Secretary of Transportation (Section 212):

MARIJUANA AND OTHER DRUG REPORT

> SEC. 212. The Secretary shall report to Congress not later than December 31, 1979, concerning the progress of efforts to detect and prevent marijuana and other drug use by operators of motor vehicles. Such report shall include, but not be limited to, information concerning the frequency of marijuana and drug use by motor vehicle operators, capabilities of law enforcement officials to detect the use of marijuana and drugs by motor vehicle operators, and a description of Federal and State projects undertaken into methods of detection and prevention. The report shall include the Secretary's recommendations on the need for legislation and specific programs aimed at reducing marijuana and other drug use by motor vehicle operators. For the purpose of this section the term "drug" means a controlled substance within the meaning of section 102(6) of the Comprehensive Drug Abuse Prevention

and Control Act of 1970 (21 U.S.C. 802(6)).

Near the end of April 1979, a contract modification was approved by NHTSA. The statement of work described the purpose of this modification:

- to update the already available literature concerning drugs as they relate to driving;
- to supplement this literature with a review of local, state, and other federal activities in this area; and
- to prepare a draft report concerning the prevention and detection of marijuana and other drug use by operators of motor vehicles, as required by Congress.

The literature search and review task was to supplement extensive reviews prepared previously by HSRI (Joscelyn, Jones, Maickel, and Donelson 1979) and others (Joscelyn and Maickel 1977a; Willette 1977; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979). The review of activity related to drugs and driving was intended to include the compilation of a "catalog of efforts" to detect and prevent marijuana and other drug use by motor vehicle operators. From available literature reviews; articles and reports collected by new searches of the literature; and information obtained from federal, state, and local agencies and organizations, information appropriate for the report to Congress was to be organized and provided to NHTSA. This document is a complete compilation of material reported to NHTSA.

SCOPE OF STUDY

The area of **drugs and highway safety** is defined by the overlap of two public health issues with broad scope: (1) problem driving behavior, including traffic crashes, and (2) the misuse and abuse of drugs. The estimated cost of traffic crashes is in excess of $40 billion per year. Approximately 50,000 persons are fatally injured in traffic crashes each year. One drug, alcohol, is found in concentrations in body fluids that indicate intoxication in forty to fifty-five percent of fatally injured

drivers. Other drugs are also found--alone and in combination with alcohol and other drugs—in concentrations that indicate misuse or abuse.

The so-called "drug and driving problem" is the relationship between the use of drugs (other than alcohol alone) by drivers and its possible adverse consequences--traffic crashes and concomitant losses. Awareness of this problem grows out of the alcohol and highway safety experience and public concern over the widespread use, misuse, and abuse of psychoactive drugs, drugs that act on the central nervous system to produce effects on behavior. In accordance with the congressional request described above and for the purposes of this report, the term **drug** includes all "controlled substances," that is, those listed in section 102(6) of the Comprehensive Drug Abuse Prevention and Control Act of 1970 (21 U.S.C. 802(6)).

The area of drugs and highway safety therefore encompasses elements of both drug and transportation research, including research to define the problem and efforts to reduce traffic crash risk due to inappropriate drug use by drivers. The study of drugs and driving involves many disciplines and several distinct areas pertaining to drugs, for example:

- pharmacology,
- toxicology,
- psychology, and
- medicine;

and to highway safety:

- traffic crash investigation (accident analysis), and
- analysis of driving task and identification of component skills;

and to both:

- determination of drug use among drivers in general, accident, and impaired driving populations (epidemiology);
- study of drug effects on driving performance and skills believed related to driving (experimentation);
- development and implementation of countermeasures.

Efforts to deal with a drug and driving problem include legal, health, public information and education, technological, and combined approaches. Development of analytical methods (e.g., analyses for drugs in body fluids) is required to support both research and prevention activities.

The scope of the study included all of these aspects of drugs and driving. The emphasis of the study, however, was on current knowledge and current practices related to the detection and prevention of inappropriate drug use by motor vehicle operators.

APPROACH

Two basic approaches--literature review and direct contact with agencies and organizations--were used in this study.

The literature review covered the following topic areas:

- research (epidemiology, experimentation);
- methodology (analysis for drugs in body fluids, techniques to measure behavior related to driving); and
- legal topics (legislation pertaining to driving under the influence of drugs [DUID] laws, federal and state regulations controlling availability of drugs or their use).

Searches of computer-based information retrieval systems (Medline, Exerpta Medica) and routine manual searches of literature sources (journals, bibliographies) identified most of the articles and reports later collected for this report. In addition, written documentation of activity identified in the course of direct contact with agencies was received.

Direct contact with federal, state, and local agencies and other organizations was made by telephone, letter, and, in two instances, by site visit. Initially, all ten NHTSA Regional Offices and all fifty Governor's Highway Safety representatives were contacted. The purpose of these contacts was to inform each official of this study and to inquire about any activity related to drugs and driving in each jurisdiction. Referrals to state and local agencies, public and private organizations, and other individuals thus obtained were noted for later contact. Based on the types of agencies of interest identified in the Statement of Work,

reference volumes were used to compile initial listings of agencies and organizations for contact in the fifty states and District of Columbia (Information Resources Press 1978 General Services Administration 1979; Congressional Quarterly, Inc. 1979a, 1979b; Yakes and Akey 1979).

The HSRI staff contacted identified agencies by telephone from June through August 1979. The initial list of sources was expanded as telephone contacts were made. Referrals were identified and contacted in turn. Fellow researchers suggested other sources of information and supplied lists of industry representatives (insurance companies, pharmaceutical companies). Letters to agency heads and lists of referrals supplemented telephone contacts. Two site visits to toxicology laboratories yielded comprehensive information on routine procedures and findings related to drugs and driving. Table 1-1 summarizes this activity by listing the various types of contacts and the number of contacts within each category.

Documents obtained under the literature search task were handled by a procedure described previously (Joscelyn and Donelson 1979). The ongoing bibliographic activity was expanded to incorporate requirements of this study. Articles and reports collected for this task and cited in this report are listed in the bibliography. Another in a series of bibliographic reports sponsored by NHTSA (Joscelyn and Maickel 1977b; Joscelyn and Donelson 1979) is planned for publication in the Summer of 1980.

Based on topics of interest outlined in the Statement of Work, information summary guides were designed and developed to capture specific data obtained through telephone contacts. Data obtained for the following topic areas were computerized to facilitate reduction and analysis:

- legislation on drugs and driving;
- health approaches to dealing with drugs and driving;
- enforcement activity aimed at drug-impaired driving;
- methods to detect and quantitate drugs in body fluids of drivers (application in research, toxicology, and enforcement); and

TABLE 1-1

DIRECT CONTACTS WITH FEDERAL, STATE, AND LOCAL AGENCIES, ORGANIZATIONS, AND INDIVIDUALS*

Type of Contact	Number of Contacts
FEDERAL	
Department of Transportation	
NHTSA Regional Offices (10)	12
Other Agencies and Offices	16
Department of Health, Education, and Welfare	32
Department of Justice	13
Department of Defense	16
Other Federal Departments and Agencies including U.S. House and Senate Committees	28
STATE AND LOCAL	
Governors' Highway Safety Representatives (50)	60
Departments of Motor Vehicles	17
State Legislative Reference Bureaus	50
Police Agencies: State	46
Local	28
Prosecuting Agencies (19)	21
State Criminal Justice Planning Agencies	18
State and Local Agencies concerned with Health, Substance Abuse, Public Safety, Traffic Safety, Education	174
State and Local Toxicology Laboratories	71
OTHER ORGANIZATIONS	
Pharmaceutical Manufacturers and their Associations (40)	55
Insurance Companies (11)	13
Health Practice (e.g., AMA, APLA, etc.)	11
Other Contacts, including Universities, and individuals active in drugs and highway safety	23
TOTAL	704

*Numbers in parentheses indicate how many different agencies were contacted; in these cases, more than one contact was made in a single agency or organization.

- experimental research studies (literature only).

Collected information in other topic areas, which was in general less detailed and not as voluminous, was recorded in the form of memoranda. Hardcopy files were created to organize information from all contacted agencies. Additional computer files were created to compile a master list of all agencies contacted along with encoded information on types of drug and driving activity (if any).

Other information was synthesized and written drafts summarizing each topic area were prepared. Finally, data from all sources were integrated and from this information base, material for this report to NHTSA was prepared.

ORGANIZATION OF REPORT

This report has eight chapters. This chapter and Chapter Two, **An Overview of Drugs and Highway Safety**, provide background on the report, on the study approach, and on the area of drugs and highway safety.

Next, three chapters discuss the state of knowledge about the relationship between the use of controlled substances and highway safety. Past, present, and planned efforts in three major areas are covered.

- Chapter Three, **Experimental Research**, describes studies of drug effects on human behavior and skills related to driving performance.

- Chapter Four, **Epidemiologic Research**, summarizes studies of drug use among driving populations, both accident- and nonaccident-involved.

- Chapter Five, **Detection and Quantitation of Drugs in Body Fluids**, discusses techniques for drug analysis and their application by agencies to detect drug use by drivers.

The next three chapters focus on the societal response to drugs and driving.

- Chapter Six, **Laws Relevant to Drugs and Highway Safety**, describes legislative efforts to control the use and

abuse of drugs and the drug-impaired driver.

- Chapter Seven, **Application of DUID Laws,** details current practices and problems in enforcing drug-impaired driving statutes, adjudicating cases involving drug-impaired driving, and sanctioning drivers convicted of drug-impaired driving offenses.

- Chapter Eight, **Information and Education Countermeasures,** summarizes activity in the areas of education and public information, and other prevention measures that are designed to reduce inappropriate drug use by drivers.

- Chapter Nine, **Conclusions and Recommendations,** presents the conclusions and implications of the study, including directions for future research and action.

- Two appendices contain detailed and technical material that supplements the text.

- A bibliography lists references cited in this report.

CHAPTER TWO

AN OVERVIEW OF DRUGS AND HIGHWAY SAFETY

The so-called "drug and driving problem" may be defined as the relationship between the use of drugs, other than alcohol alone, by motor vehicle operators and its possible adverse consequences—traffic crashes and associated losses. Work on drugs and highway safety includes research to define the problem and efforts to reduce the highway safety risk due to drugs. Awareness of this problem grows out of the alcohol and highway safety experience; concern about drugs and driving parallels concern over the widespread use and abuse of psychoactive drugs in our society. As indicated in Chapter One, the focus of this report is on marijuana and other controlled substances, including both licit and illicit drugs. This chapter

- summarizes the present state of knowledge of drugs and highway safety;
- presents a conceptual framework that organizes topics covered by this report;
- defines approaches taken both to define and to deal with the drug and driving problem; and
- describes how the alcohol and highway safety experience relates to drugs and driving.

Chapters Three through Eight expand treatment of topics included in this section.

DRUGS AND HIGHWAY SAFETY: THE PRESENT STATE OF KNOWLEDGE

Briefly stated, the extent to which drugs contribute to problems in highway safety is unknown. Despite an ever-expanding body of literature, the state of knowledge of drugs and driving remains limited. Reviewers

of research linking drugs and highway safety (Perrine 1975; Joscelyn and Maickel 1977a; Willette 1977; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979; Joscelyn, Jones, Maickel, and Donelson 1979) have generally concluded that definitive studies are lacking. Nevertheless, the available evidence indicates that drugs **can** impair driving skills, that drugs **may** increase the likelihood of traffic crashes, and that further inquiry is warranted.

Research and police investigations have documented drug involvement in specific crashes and have led to the conclusion that drug-impaired driving has been a causative factor in crashes. Drivers are regularly, but relatively infrequently, detected, arrested, prosecuted, and convicted for drug-impaired driving. These specific instances lend credence to the belief that a drug and driving problem exists. Unfortunately, the magnitude of the drug and driving risk is unknown. The magnitude must be established before drugs and driving can be properly termed a highway safety problem. **The evidence to date has not established that drugs other than alcohol should take priority among highway safety concerns.**

The most general description, perhaps, is that the relationship between drugs and highway safety is highly complex and, at best, indirect. Whether the driving task itself is considered simple or complex, the human element precludes straightforward statements of cause and effect. A tendency to single out drugs as "causative" factors in some traffic crashes must be tempered with recognition that drugs influence human behavior or skills, which, in turn, may significantly increase—or, in the case of therapeutic agents, may decrease--the risk of a crash. The importance of human factors in highway safety is appreciated but not well understood. How often drugs provoke driving behaviors that lead to traffic crashes, therefore, is similarly uncertain.

The complexity of the problem requires equally complex research to define the problem. That this research has not yet been done stems from many factors, including:

- the large number of drugs in use by the general population;

- the lack of large-scale, coordinated research efforts;
- the legal, ethical, and practical constraints on research;
- the methodological problems in research;
- the cost of definitive research combined with a scarcity of funding; and
- (until recently) the absence or unavailability of adequate chemical tests for the presence and amount of drugs in body fluids.

Two other considerations deserve mention. **First**, most psychoactive drugs are used to treat medical conditions that may themselves--if untreated--increase the likelihood of traffic crashes. Do the therapeutic effects of these drugs offset their potential to affect driving performance adversely? Most driving-related studies employ healthy, male, college-age volunteers. Such studies cannot answer questions about drug-disease interactions that may be positive for highway safety.

Second, drugs are often used in combination, especially with alcohol. Interpretation of the effects of a single drug is difficult; interpretation of the combined effects of two or more drugs is more so. What proportion of the drug and driving problem, for instance, is actually an alcohol-plus-other-drug and driving problem? To what extent do therapeutic dosages of drugs combined with alcohol at concentrations below the legal limit impair one's ability to drive safely?

These and other unanswered questions indicate that policymakers should assess the implications of past research with great caution. On one hand, no amount of research with narrow focus can adequately define the drug and driving problem. On the other hand, no single study, however far-reaching and costly, can determine the nature and extent of the problem. Required is a series of projects, coordinated and designed to encompass the complexity inherent in the problem itself. The need for a more integrated view of drugs and driving becomes evident.

AN OVERVIEW OF ACTIVITY RELATED TO DRUGS AND HIGHWAY SAFETY

A general description of this area of highway safety follows. A conceptual framework that interrelates efforts relevant to drugs and driving is presented. Its purpose is twofold: (1) it serves to organize the topics and subtopics discussed in this report; and (2) it provides a heuristic basis for recommending more concerted activity in this area.

Activity related to drugs and highway safety comprises several research areas and many disciplines. It includes:

- research to define the nature and extent of the problem;
- programs, preventive measures, and other activity to reduce highway safety risk associated with the use of drugs; and
- research and development of methods to support efforts to define and to deal with the problem.

Figure 2-1 illustrates in more detail the scope of this activity.

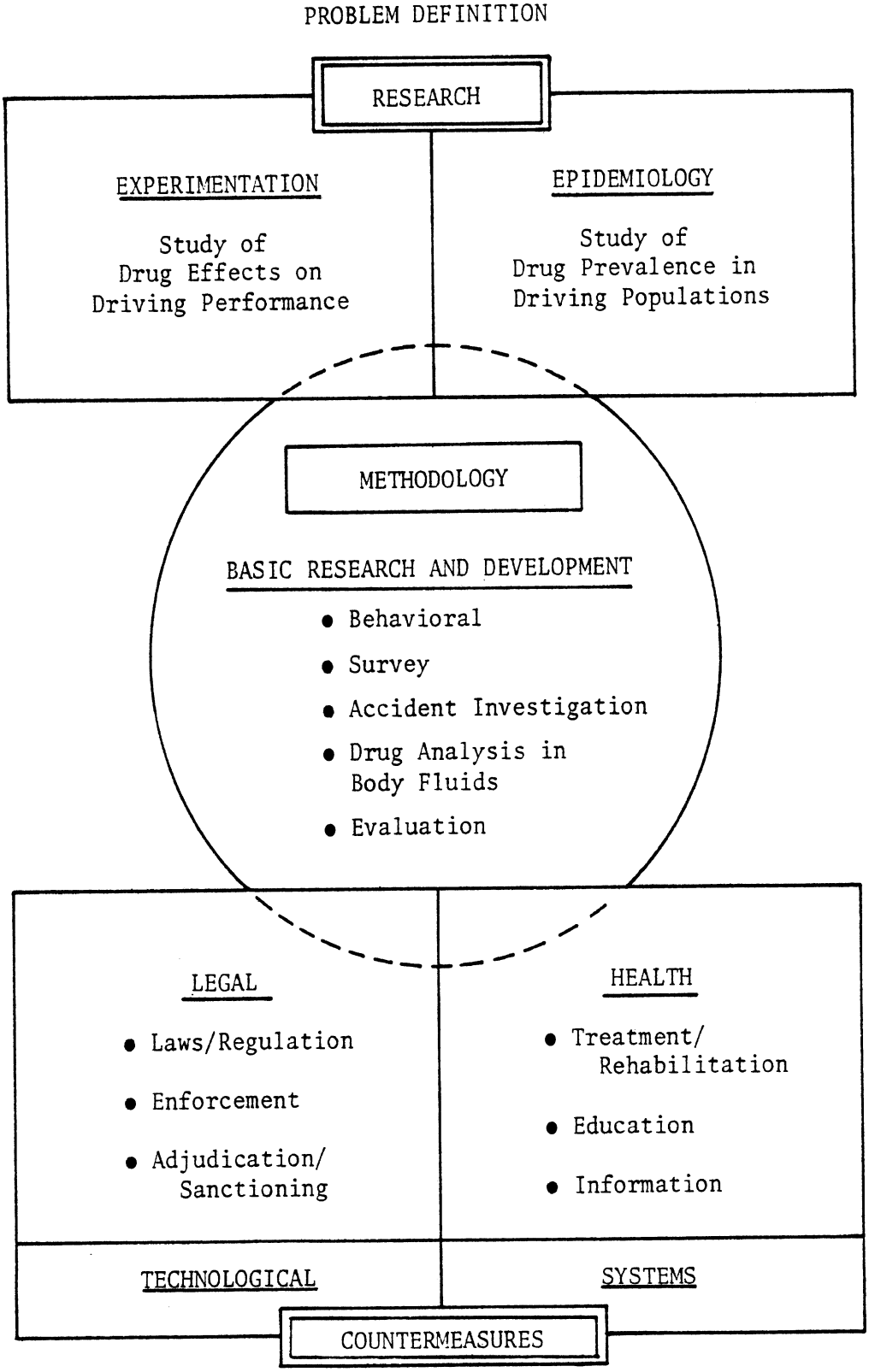
Problem Definition: Research to Define the Relationship Between Drugs and Highway Safety

Two basic research approaches, experimentation and epidemiology, have been used to study the drug and driving problem. These approaches are distinct but complementary. Neither one, taken alone, can define the problem.

Most research involves experimentation of some kind. Here, however, the term **experimental research** refers to controlled studies that examine some aspect of the drug and driving problem. Most common are studies that measure the effects of drugs on human behavior or skills believed related to safe driving performance. Legal and ethical constraints restrict this kind of research to the laboratory or to closed driving courses. Not as common, but just as important given the limitations of experimental research, are studies that describe the interaction of variables pertaining to the subjects and conditions of these experiments. By characterizing the nature and degree of drug effects, as

FIGURE 2-1

DRUGS AND HIGHWAY SAFETY:
A STRUCTURAL REPRESENTATION



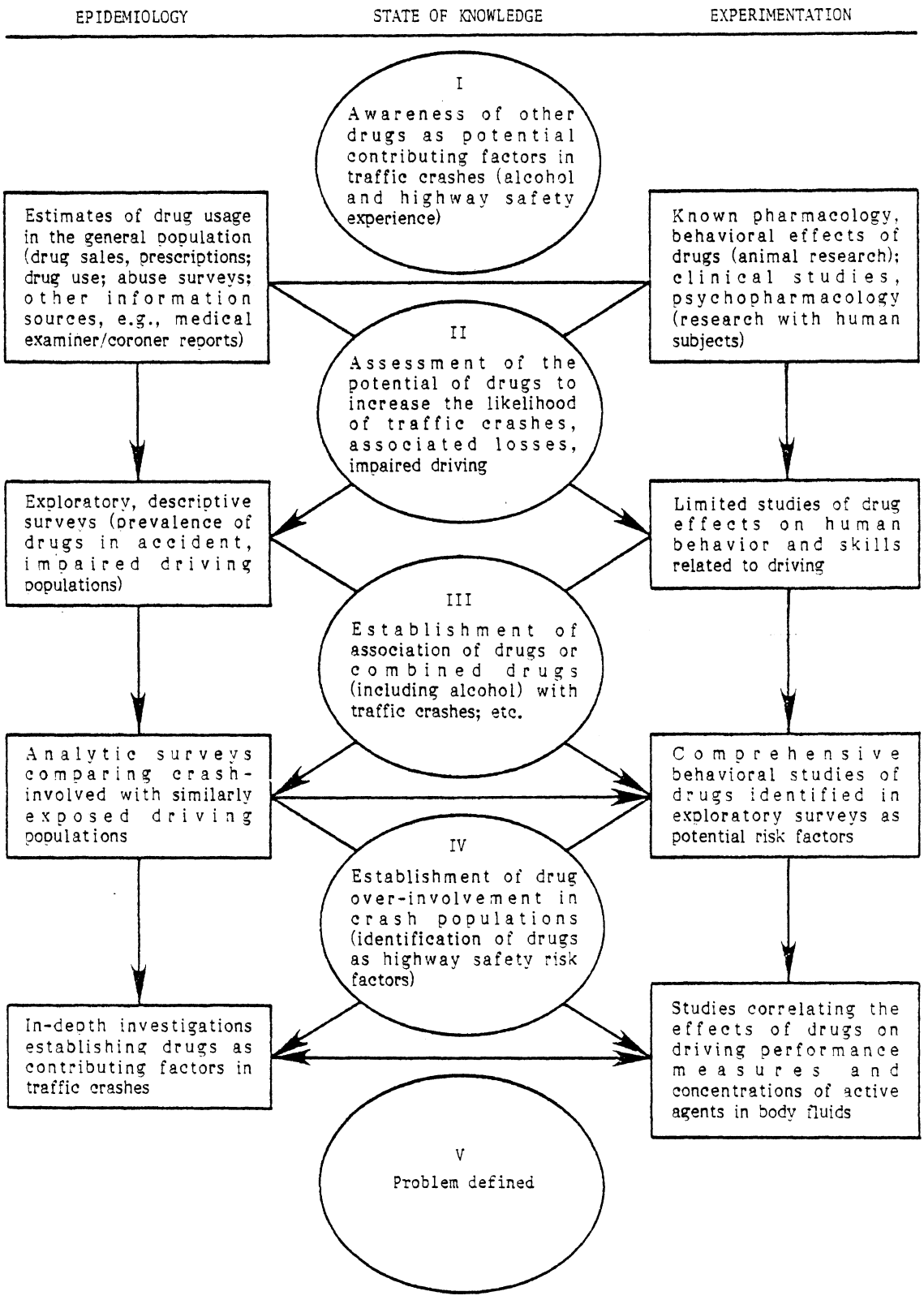
well as variables that enhance or mitigate drug effects, experimental research attempts to assess the **potential** of drugs to increase the likelihood of traffic crashes.

Epidemiology is the science concerned with the incidence, distribution, and control of disease in a population. The methods of epidemiology have been widely applied in studies of social phenomena, such as drug use and related problems. Information on the use of drugs by the general population indicates the potential for traffic crashes involving drugs. More direct information on the extent of drug use by driving populations is required. The information required includes, for example, the type and amount of drugs present in drivers from accident- and nonaccident-populations; characteristics of drug- and nondrug-using drivers; and characteristics of drug- and nondrug-related traffic crashes (Joscelyn et al. 1979). Past studies have ranged in directness from the examination of driving records of drug user groups to the analysis of driver body fluids for drugs. Rarely have studies comparing the prevalence of drugs in accident and nonaccident driving populations been conducted. Valid, controlled studies are essential to defining the drug and driving problem. The aim of epidemiologic research is to describe the extent to which drug use is associated with traffic crashes and to show how drug effects may interact with other factors associated with traffic safety problems.

Figure 2-2 depicts research on drugs and driving as a process that advances the state of knowledge toward a definition of the problem. Progressively more rigorous studies using both epidemiologic and experimental approaches are required. Arrows represent the output of research efforts; findings from epidemiologic research can be used for more in-depth experimental studies, and vice versa. Initial, exploratory research narrows the focus of later efforts, for example, by identifying a limited set of drugs of interest. This coordination of research becomes essential as the overinvolvement of particular drugs is estimated. Certain drugs may be associated with other risk factors that contribute significantly to traffic crashes; mere presence does not indicate that a drug "caused" an accident. Data on concentrations of active agents associated with impairment of driving-related skills, for example, can

FIGURE 2-2

PROBLEM DEFINITION IN DRUGS AND HIGHWAY SAFETY AS A PROCESS: COMPLEMENTARITY OF EPIDEMIOLOGIC AND EXPERIMENTAL RESEARCH



confirm and extend the findings of field surveys. Because no single study can define the drug and driving problem, **comparability** of data among different research efforts becomes a critical issue.

Problem Solution: Efforts to Reduce the Risk of Drugs to Highway Safety (Countermeasures)

Because the problem has not been defined, the primary emphasis in drugs and driving has been on research, both experimental and epidemiological. Nevertheless, discussions of possible countermeasures have appeared in the literature (Forney and Richards 1975; Whitehead and Ferrence 1976). Existing state laws concerning driving under the influence of drugs have been enforced sporadically (e.g., Garriott and Latman 1976). In their recent review, Joscelyn et al. (1979) describe underlying concepts of drug countermeasures and their constraints. In advocating a rational, systematic approach to the drug and driving problem, such as that for alcohol-crash programs (Voas 1975), they stressed that "the lack of knowledge of the role that drugs play in traffic crash causation constitutes the most basic constraint on countermeasure development" (Joscelyn et al. 1979, p. 128). At the same time, these authors pointed out that "obviously impaired drivers should not be ignored simply because the full extent of a national drug and driving problem has not been defined. Impaired drivers should be detected, apprehended, and dealt with according to local law" (Joscelyn et al. 1979, p. 211).

In general, countermeasure approaches for other drugs, both proposed and practiced, parallel those for alcohol (Jones and Joscelyn 1979a, b). Countermeasures may be directed at the use of drugs by drivers (or the general population) or at the operation of motor vehicles by drug users. Specific objectives of drug countermeasures vary. One approach may focus on decreasing the availability of drugs to drivers (for example, influencing the prescribing habits of physicians); another approach may be to prevent drug users from driving (for example, license suspension, incarceration). Table 2-1 identifies five general countermeasure approaches and provides specific examples.

TABLE 2-1

COUNTERMEASURE APPROACHES PROPOSED OR IMPLEMENTED FOR ALCOHOL, OTHER DRUGS, AND HIGHWAY SAFETY

APPROACH	DEFINITION	EXAMPLE(S)
Legal	Laws, their enforcement, leading to prosecution and sanctioning of violators	Indirect: prohibition, federal regulations restricting drug availability Direct: state "driving under the influence of drug" laws
Health	Involvement of the health care system, either in its role in the delivery of drugs or information about them to patients, or in the treatment and rehabilitation of those that have used them	Indirect: modify physicians' prescribing patterns, drug abuse treatment/rehabilitation Direct: treatment of court-referred drivers convicted of driving under the influence of drugs
Information and Education	Presentation of media material to inform general population or subpopulations in such a way that the prevalence of high-risk behavior decreases	Indirect: information and education campaigns concerning the adverse health effects of drug use or abuse Direct: inclusion in driver education programs of factual material on drugs and driving
Technological	Application of modern technology to reduce the influence of drugs on highway safety	Roadside drug detection devices
Systems	Problem dealt with in its entirety, its facets and their interactions examined to discover optimal solution	Alcohol Safety Action Program (ASAP)

Research and Development of Methodology to Support Efforts to Define and to Deal with the Drug and Driving Problem

Many of the deficiencies noted in reviews of research on drug and driving stem from methodological problems. Some of these problems also limit state or local attempts to deal with drug-impaired drivers, for example, detection of drugs in body fluids. Basic research to resolve methodological issues and the development of needed techniques or methods are essential to advance applied research on drugs and highway safety.

Experimental research depends on continued analysis of the driving task and its component skills, especially perceptual and cognitive requirements. Behavioral methods for measuring the effects of drugs must also be analyzed--for their specificity and sensitivity as well as their relation to actual driving performance. Research on experimental design is needed to answer questions about confounding variables such as human subject characteristics and chronic versus acute drug regimens.

Epidemiologic research has been limited by inadequate methods for drug analysis in the body fluids of drivers. Until recently, the use of some drugs, such as marijuana, could not be detected. Methodology for roadside surveys is critical; unless the rate of subject cooperation in studies of the at-risk driving population is very high, findings that drugs are overinvolved in accident populations will be suspect due to possible bias. Finally, methods developed to investigate traffic crashes may be applied in the in-depth study of crashes involving drugs. In this way, driver behaviors or errors associated with the use or presence of certain drugs may be characterized.

Methods to support countermeasures directed at the drug and driving problem include the following:

- drug analysis in body fluids, perhaps portable devices for roadside use;
- behavioral methods for the detection of drivers impaired by drugs, other than alcohol alone, by enforcement officers;
- development of effective public information and education campaigns focused on the use of drugs by drivers; and

- evaluation research for assessing the effectiveness of countermeasures.

Methodology as well as technology for drug and driving research and countermeasures are the subjects of research in other, ostensibly unrelated fields. For example, the New York Department of Motor Vehicles undertook a project to develop driving simulator methodology to study "the feasibility of the partial automation of the license testing process . . ." (O'Brien 1978, p. 9). A spin-off of this project was a planned research study on the effects of drugs on behavioral measures incorporated in the simulator. Another example is seen in the technical advances in analytical chemistry (Vinson 1979): modern instrumentation, techniques, and specific methods for the detection and quantitation of drugs in physiological fluids can be transferred and applied to highway safety as appropriate. It is incumbent upon researchers, highway safety practitioners, and policymakers alike to maintain an awareness of such developments in fields peripheral, but relevant, to drugs and driving.

THE ALCOHOL AND HIGHWAY SAFETY EXPERIENCE: RELATION TO DRUGS AND DRIVING

No report on the relationship between drugs other than alcohol alone and highway safety can neglect mention of the alcohol-crash problem--its definition and approaches taken to reduce losses from alcohol-related crashes. Not only are other drugs often used in combination with alcohol, but the alcohol and highway safety experience has greatly influenced both research on other drugs and societal responses to the perceived drug and driving problem.

Alcohol is one of many drugs, but unique in a chemical sense and in its use. Unlike most modern psychoactive drugs, the discovery of alcohol, its use, and (probably) its misuse lie beyond historical reach. Both praised and reviled, the effects of alcohol have long attracted social concern. Problems related to alcohol consumption predate modern transportation; patterns of drinking behavior were not superimposed on driving, but vice versa. The advent of the private automobile simply

added driving performance to alcohol's potential to impair human behavior. The same cannot be said for most other drugs.

Basic attitudes toward alcohol still influence societal responses to the drinking-driving problem. The alcohol-crash problem has, therefore, a social psychological dimension that extends beyond the scope and practice of highway safety per se (Cisin 1963). This dimension is shared, perhaps, by problems with some controlled substances, whose "recreational" use may have adverse consequences for traffic safety. Therapeutic drugs have another dimension--their accepted use for treatment of medical conditions. Nevertheless, the alcohol and highway safety experience represents a background against which all other drugs are scrutinized.

Reviews of alcohol and highway safety have documented the history and present state of knowledge about the alcohol-crash problem (Goldberg and Havard 1968; U.S. Department of Transportation 1968; Perrine 1974; Organisation for Economic Co-operation and Development 1978; Jones and Joscelyn 1979; U.S. Government Accounting Office 1979). Other reviews have critically evaluated studies of the effects of alcohol on human performance related to driving (Wallgren and Barry 1970; Perrine 1973; Levine, Greenbaum, and Notkin 1973; Perrine 1974). It is not the purpose of this section to summarize the present state of knowledge of the alcohol-crash problem. Rather, the intention is to discuss key elements of the alcohol and highway safety experience in relation to drugs and driving. The following subsection briefly outlines the history of alcohol and highway safety. A subsequent subsection discusses its implications for drugs and driving.

The Perception of an Alcohol-Crash Problem and Research to Determine Its Magnitude

Given the social climate of the early 1900s, it is hardly surprising that alcohol immediately became suspect as a factor in traffic crashes. Observations of alcohol's role in highway mishaps were forthcoming as early as 1904 (The Quarterly Journal of Inebriety 1904). By the 1930s, amid increasing concern over the magnitude of the drinking driving problem, the scientific study of the problem was defined and advocated

(Heise 1934). Basically, two approaches to define the alcohol-crash problem, experimentation and epidemiology, were supported by a third: measurement of the **amount** of alcohol in the body. This was consistent with the fact that the mere presence of a substance in the body is necessary but not sufficient evidence of its effect.

A proven and useful variable, **blood alcohol concentration** (BAC), describes the amount of alcohol contained in a given volume of blood. Early technical advances in analytical chemistry supplied numerous qualitative and quantitative chemical tests for alcohol. Armed with this methodology, researchers proceeded (1) to establish the overinvolvement of alcohol in traffic crashes compared to samples of nonaccident driving populations; and (2) to correlate the **effects** of alcohol on measures of human performance related to driving and its **concentration** in body fluids. The development of chemical tests of alcohol in breath as an accurate estimate of BAC, increased the ease with which data on the alcohol-crash problem accumulated.

Efforts to Deal With the Alcohol-Crash Problem

As evidence emerged that alcohol was a highway safety problem, countermeasures were developed and implemented. Laws were passed prohibiting alcohol-impaired driving. As chemical tests to measure alcohol levels in the body became more widely available and, importantly, as information correlating the effects of alcohol with its levels in the body was scientifically established, test results were accepted in criminal trials as evidence of impairment. At first, the alcohol level was used to establish the presumption of impairment. More recently statutes have been passed that make it illegal per se to operate a motor vehicle with a concentration of alcohol in the body above a certain amount.

At the same time, education and information efforts were undertaken to establish a public knowledge base about alcohol and highway safety. This was done to deter people from driving unsafely and to create public support for actions against those who drove while impaired. Sanctions against those convicted of alcohol-impaired driving included the traditional sanctions of fine and imprisonment, driver license suspension and

revocation, and referral to health and education programs. The last approach has been characterized as the health/legal approach.

The development of countermeasures and responses to the alcohol-impaired driver has been primarily a state and local effort. Since 1966 the federal government, through the efforts of NHTSA and National Institute on Alcohol Abuse and Alcoholism (NIAAA), has played a significant role in both stimulating and supporting state efforts. The federal role continues today.

Despite the federal, state, and local efforts, alcohol continues to be a major highway safety problem. Its nature and magnitude can be estimated but is not fully defined. Approximately forty to fifty-five percent of the drivers involved in fatal crashes have alcohol concentrations in excess of .10% w/v—the legal limit for alcohol-impaired driving in most states. Comparable figures for personal injury and property damage crashes are nine to thirteen percent and five percent, respectively. Such data in the past have been inaccurately generalized to statements that fifty percent of traffic crashes are caused by alcohol. Such statements are not true, but alcohol is clearly a significant highway safety problem.

The magnitude of the alcohol problem can be estimated and a foundation has been established for actions to reduce the alcohol-crash risk because extensive study of the problem has occurred over many years. Despite the present advanced state of the knowledge about alcohol and highway safety, it remains a highway safety problem. Our knowledge about drugs and driving is much less. The alcohol and highway safety experience demonstrates that alcohol and drugs other than alcohol are major societal problems. The problems are long-term in nature and will require an equally long-term view to address them. These and other highway safety problems are best perceived and addressed in a broad public health context.

Implications of the Alcohol-Highway Safety Experience for Research and Other Activity Concerning Other Drugs

The incomplete, skeletal outline of the alcohol-highway safety

experience presented above hardly does justice to the large body of available information. Nevertheless, it does provide some basis for comparing alcohol and other drugs. These comparisons have strong implications for the conduct of research on drugs and driving and the development of countermeasure programs.

The 1926 Uniform Vehicle Code listed "narcotic drugs" and "habitual users of narcotic drugs" under its model statute dealing with driving under the influence of intoxicating liquor. In 1944, the Code was revised to include persons driving under the influence of nonnarcotic drugs, including therapeutic drugs legally used (National Committee on Uniform Traffic Laws and Ordinances 1972, p. 613). But prior to 1960, little interest in possible highway safety problems due to other drugs was expressed. Three trends in the use of psychoactive drugs probably account for the (relatively) recent and growing concern over other drugs and highway safety.

1. the continued development and widespread use of novel psychoactive drugs for the medical treatment of physiological and psychological conditions;

2. the tremendous increase in the nonmedical use of drugs (including the misuse and abuse of licit, therapeutic agents and the illicit use of other chemical substances such as marijuana and PCP); and

3. the combined use of alcohol and other psychoactive drugs, both licit and illicit.

The known effects of these drugs combined with their widespread use in a mobile, car-loving society are prima facie evidence that a drug and driving problem exists. But whereas the alcohol-crash problem has been known and studied for over half a century, drugs and driving as a recognized area of highway safety is comparatively new and underdeveloped. Its cadre of full-time investigators is few in number and spread thin over research covering literally hundreds of drugs. Unlike the well-funded, coordinated efforts devoted to alcohol, research on other drugs is fragmentary, often cursory, independent, widely scattered, and mostly experimental, and the results of research projects are rarely

comparable. Though much has now been published, little is known about the nature and extent of the drug and driving problem.

One researcher ascribed the "prolonged infancy" of drug and driving research to the large number of drugs to be considered and to the need for technological innovations in toxicology and biochemistry (Smart 1977). Recent developments in drug analysis and the identification of limited sets of drugs of interest (Willette 1977; Joscelyn and Donelson 1980) address these constraints. But differences among alcohol and other drugs should temper expectations of sudden maturity in research on drugs and driving.

Table 2-2 compares alcohol with "other drugs" in terms of their chemistry, pharmacology, use, and availability. Dissimilarities have implications for the kind of highway safety risk indicators that are developed as well as for possible preventive measures that are applied. For example, alcohol's physical and chemical properties permit its detection and quantitation in body fluids by relatively simple, inexpensive tests. The content of alcohol in breath is proportional to its concentration in blood, and noninvasive techniques are used to identify persons driving under the influence. Analysis for other drugs, which are more complex structurally and less volatile, requires specimens of blood for meaningful judgment about possible drug effects--physiological, psychological, or behavioral. Relationships between concentrations in the blood and effects are much more complex for drugs other than alcohol; threshold concentrations of drugs that impair driving performance have not been determined other than for alcohol. Even for alcohol, relatively high concentrations are required before the statement that **all** drivers are impaired can be made. Toxicologic results indicating polydrug use are even more difficult to interpret, since a quantitative understanding of combined drug effects is lacking. **In summary, the ability to detect and quantitate drugs in body fluids exceeds our present knowledge of what these measurements mean.**

Differences between alcohol and other drugs extend to their availability, use, and legal status. Alcohol is freely available and used to some extent by over sixty percent of the U.S. population. No other

TABLE 2-2

COMPARISONS BETWEEN ALCOHOL AND OTHER DRUGS

Alcohol	Characteristic	Other Drugs
Single chemical entity	CHEMISTRY	Numerous, diverse chemical entities, some substances (e.g., marijuana, opium) are complex natural products. There are many different classes of drugs.
Small, simple molecule		The chemical structure of most other drugs is complex.
A general depressant that may have both excitatory and inhibitory effects (biphasic action). The effects are dose and time dependent.	PHARMACODYNAMICS (effect of a substance on the body)	Most drugs have more selective action than do general depressants. There are a wide range of effects: depression, stimulation, analgesia, hallucination, antianxiety action, etc. Also dose and time dependent.
Tolerance and dependence		Tolerance and dependence are seen for some drugs or classes of drugs. Some drugs show enhanced potency with chronic use.
It is absorbed rapidly, distributed like total body water (at equilibrium), enters metabolism of the body (energy source), and is excreted in the urine and breath.	PHARMACOKINETICS (effect of the body on a substance)	Pharmacokinetics of other drugs is much more complex. Great variations from drug to drug in the rates of absorption, distribution, metabolism, and excretion. Most drugs are present in the body in both active and nonactive forms. Other drugs are metabolized primarily in the liver. Compounds with pharmacologic activity can be produced from the parent drug (active metabolites). Most drugs (or their metabolites) are excreted in the urine or bile. Due to low volatility, almost all other drugs are not found in the breath in significant amounts.
The most common use is recreational (e.g., social drinking), but other patterns exist, including alcoholism.	USE OR EXPOSURE in the general or driving population	Patterns of use for drugs include: recreational (e.g., marijuana, cocaine), therapeutic, illicit use or misuse of therapeutic drugs, and self-medication.

TABLE 2-2

COMPARISONS BETWEEN ALCOHOL AND OTHER DRUGS (Continued)

ALCOHOL	CHARACTERISTIC	OTHER DRUGS
Its use is widespread with general acceptance of alcohol use but not of abuse. The frequency and quantity of use varies from heavy drinking to infrequent consumption. Only about 30% of the general population abstains from alcohol use.	AVAILABILITY	Almost all drugs are much less-widely used than alcohol. The therapeutic use of drugs, but not their nonmedical use, is sanctioned by law. Patterns of drug use are not well defined for most drugs.
Available through relatively loosely controlled retail outlets (like an "over-the-counter" drug) with age limits for purchase.		Federal and state governments regulate production, marketing, and availability of controlled substances, as well as most other drugs. Licit drug distribution is through the health-care system (primarily through physicians and pharmacists) while illicit drug sales are through "street marketing" (e.g., marijuana).
Alcohol users reflect the total population (in terms of age, socio-economic level, etc.).	USER POPULATION	The characteristics of the drug user population varies according to the drug and its legal status.
There are relatively simple tests available to detect and quantitate the amount of alcohol in breath, blood, urine, and other body substances. Alcohol, which is present in relatively large amounts, can be analyzed using portable breath-testing instruments.	CHEMICAL TESTS on body fluids or breath	Analysis is relatively complex for almost all controlled substances. Instrumentation is expensive and nonportable. Presently, blood specimens are required to determine amount of drug present in the body. Only minute quantities of these psychoactive drugs are required to produce measurable effects.

single drug--with the exception of caffeine, a noncontrolled substance—is used by as great a proportion of the population. Nevertheless, the level of use of controlled substances in general may approach that for alcohol (e.g., Brecher 1972). Unfortunately, as noted elsewhere (Institute of Medicine 1979; U.S. Department of Health, Education, and Welfare 1979), comprehensive data on the use of controlled drugs--medical and nonmedical--is not available and accurate estimates are rarely, if ever, possible. In contrast to that for alcohol, the production, marketing, and distribution of other drugs are more tightly regulated. Some substances, such as marijuana, are simply prohibited, except for use in research conducted according to federal regulations. The more complex and formal delivery systems for drugs other than alcohol appear to offer more intervention points for countermeasure action (e.g., scheduling or rescheduling substances) than presently feasible for alcohol use.

One element of the alcohol and highway experience cannot be overemphasized: **blood alcohol concentration** (BAC). As an objective measure of alcohol presence and effect, BAC has enabled epidemiologic research to demonstrate a strong association between alcohol and traffic crashes; the higher a person's BAC, the more likely a traffic crash will occur. BAC has also enabled experimental research to establish relationships between the amount of alcohol consumed and likely impairment of driving behavior.

BAC equivalents do not now exist for any other drug. Research aimed at developing BAC equivalents for some other drugs (behavioral, pharmacokinetic studies) is ongoing; however, present knowledge about the relationship between concentrations of drugs (other than alcohol) in body fluids and their effects on behavior holds little hope for quick development of BAC equivalents. Today, for example, interpretation of drug concentrations in body fluids is at best an art and at worst impossible. Because measurement of BAC has been so important to alcohol and highway safety, research and countermeasures developed for alcohol may not be appropriate for other drugs. Nevertheless, many drug countermeasures, both proposed and implemented, are patterned after approaches used to deal with the alcohol-crash problem.

SUMMARY

The relationship between drug use by drivers and problems in highway safety has not been defined. The state of knowledge about drugs and driving is limited, despite numerous reports that drugs can impair driving skills and may increase the likelihood of traffic crashes. Although available evidence does not establish that drugs other than alcohol are priority concerns in highway safety, present information does warrant further inquiry.

Research to define the drug and driving problem is complicated by many factors, among them the therapeutic use of most drugs and the trend toward multiple drug use. Both experimental and epidemiologic research are required to define the problem. In particular, studies comparing the prevalence of drug use among accident- and nonaccident-driving populations are needed to describe the association between drugs and traffic crashes.

Countermeasure approaches to reduce highway safety problems due to drug use by drivers correspond to those for alcohol. Development of countermeasures for other drugs is constrained by the lack of information on the kind of drugs or the groups of drivers that should be targets of action programs.

Research and development of methods to support efforts both to study and to deal with the drug and driving problem are also required, including:

- valid and reliable behavioral methods to measure the effects of drugs on skills related to driving, and to detect drug-impaired drivers;
- sensitive analytic methods to measure the presence and amount of drugs in body fluids; and
- methods to support specific countermeasures aimed at the drug and driving problem.

The most studied drug and driving problem--the alcohol-crash problem—influences approaches to research and countermeasures for other drugs. The alcohol and highway safety experience provides a perspective

for viewing the drug and driving problem, but differences between alcohol and other drugs indicate that all elements of that experience may not be applicable to other drugs. The pivotal role of blood alcohol concentration (BAC) alone suggests that some approaches to dealing with the alcohol-crash problem cannot be used effectively for many other drugs.

CHAPTER THREE

EXPERIMENTAL RESEARCH

Experimental research in drugs and highway safety serves to answer the following questions:

- Do drugs impair human behavior or skills related to driving?
- Do the combined effects of drugs including alcohol impair driving-related behavior or skills? and
- How are measures of driving performance related to measures of drug use--for example, amount of drug taken, frequency of use, concentration in body fluids, etc.?

The basic purpose of experimental research is to assess the **potential** of drugs to increase the likelihood of traffic crashes and associated losses. This section:

- briefly summarizes the state of knowledge in this area of research;
- describes past research on marijuana and other drugs;
- outlines issues pertaining to methodology and experimental design that must be addressed in future research; and
- identifies ongoing and planned research.

THE STATE OF KNOWLEDGE

The study of drug effects on measures of driving performance and related skills has produced a large but widely dispersed volume of literature. **Bibliographies** (Barnes 1974; Joscelyn and Maickel 1977b; Joscelyn and Donelson 1979), **research reviews** (Moskowitz 1976b; Joscelyn and Maickel 1977a; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979; Joscelyn et al. 1979), and periodic **conferences** (Perrine 1974; Joscelyn and Maickel 1977c; Willette 1977) have assembled and evaluated the many reports relevant to

drugs and driving. As reviewers have consistently noted, however, the wealth of data belies a paucity of information relating drug effects, performance on laboratory tests, driving behavior, and traffic crashes.

Criticism of past research points to:

- **Deficiencies in Methodology.** Many tests routinely employed have limited validity or no demonstrable relation to real-world driving. Methods measuring the "same" behaviors often differ, raising questions about the comparability of experimental findings.

- **Weaknesses in Experimental Design.** Inadequate designs and poor selection of subjects are common features of laboratory studies. Compounding these faults are the incomplete reporting of methods for behavioral measurement-data analysis and the absence of critical variables, for example, concentrations of active agents in body fluids.

- **Lack of Realism in Laboratory Studies.** Aside from behavioral tests that bear little or no resemblance to actual driving, most studies fail to reflect patterns of drug use in the general population. Since any substance in excess can be toxic, the **amounts** of drugs administered and the **frequency** of repeat doses should be similar to common usage. In addition, experimental subjects should be representative of actual users. Few studies meet these conditions for relevance.

Reasons for disarray in experimental research have been attributed to the number and diversity of drugs and their effects; to the wide range of methods to measure behavior; and to the host of variables pertaining to drug, subject, and experimental design. Obviously, no experiment can control or measure all relevant variables. Yet, reported research taken as a whole lacks depth, even as Perrine (1973) commented on the alcohol/driving literature:

> Perhaps more so than with any other specialty in behavioral science, the alcohol literature seems to be cluttered with the bones of isolated, poorly controlled, one-shot studies by investigators who were probably just curious about what happened when alcohol was simply added as a treatment condition in an area of research which they had already been pursuing. Thus, the greatest single need appears to be a willingness on the part of investigators to pursue a line of

> research in sufficient depth to permit definitive statements to be made about the particular topic or subtopic which they are examining. (pp. 165-66.)

Experimental research on drugs and driving shares many of the faults evidenced by alcohol studies, in particular the absence of in-depth investigations. The lack of adequate research, therefore, may stem more from the uncoordinated, discontinuous, and scattered efforts than the quality of work done to date. The state of knowledge suffers, resulting in equivocal statements about the potential risks of many drugs (other than alcohol alone) to highway safety.

Nevertheless, despite the deficiencies of experimental research, accumulating reports of much-studied drugs (e.g., marijuana, diazepam [Valium®]) indicate that their use by drivers, especially when combined with alcohol, may lead to an increased likelihood of traffic crashes. Past experimental research, which has limited value for predicting adverse effects on highway safety, emphasizes the importance of epidemiologic studies to confirm these findings. Nevertheless, studies of drug effects on human behavior and skills related to driving performance do indicate the potential of drugs to increase traffic crash risk. Overall, experimental findings support cautions and warnings against driving while under the influence of drugs that might impair driving-related skills.

EXPERIMENTAL RESEARCH FINDINGS

In summarizing past experimental research on marijuana and other drugs, this report relies on extensive, comprehensive reviews of the existing literature (Moskowitz 1976a; Willette 1977; Joscelyn and Maickel 1977a; Valentine, Williams and Young 1977; Wesnes 1977; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979; Joscelyn et al. 1979) as well as reviews of particular drugs or drug classes. Searches of computer-based information retrieval systems (Medline, Exerpta Medica) revealed few reports not reviewed elsewhere. Articles and reports published since the most recent reviews do not alter current assessments of drug effects. The in-depth, recent reviews cited above direct the reader requiring more detailed information to its sources

in the literature.

Marijuana

Research on marijuana has increased in proportion to its use (Petersen 1977). The examination of marijuana--its use and the consequences of its use--covers many aspects of public health. One area of continued interest has been its effects on driving performance and its influence on highway safety. Because chemical tests for the presence and amount of marijuana constituents in body fluids have only recently been developed (Vinson 1979), almost all research has been experimental.

Experimental research on marijuana covers the complete range of methods to measure driving performance and related skills (Moskowitz 1977; McBay 1977; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979; Joscelyn et al. 1979). For example, the effects of marijuana adversely affected driving performance under actual road conditions, though some subjects performed better (Klonoff 1974). Hansteen et al. (1976) reported a study comparing the effects of marijuana and alcohol on driving performance using a closed course; the higher of two doses of marijuana resulted in poorer car handling, while observers in the test car rated the subjects' performance similar to placebo conditions. Studies with driving simulators (Crancer et al. 1969; Dott 1972; Rafaelson et al. 1973; Moskowitz, Hulbert, and McGlothlin 1976) showed that marijuana degraded performance on some--but not all--variables measured. For example, Moskowitz, Hulbert, and McGlothlin found no significant effect of delta-9-tetrahydrocannabinol (THC, a major active agent in marijuana) in doses up to 200 micrograms per kilogram bodyweight on twenty-five performance measures related to car control (steering wheel, brake, and accelerator pad usage). However, in a subsidiary visual search and recognition task, dose-related increases in reaction time and increased response errors indicated significant effects on perception. Other laboratory studies, using specific mental, psychomotor, and sensory tests, have shown impairment by marijuana, depending on dose and type of task, for example, altered time sense, reaction time, perceptual motor coordination, and auditory signal detection

(Jones 1977).

Experimental research, taken as a whole, indicates that marijuana can impair tracking and perceptual functions involved in driving (Moskowitz 1976a; Moskowitz 1976c). Perception and other mental functions appear more affected than simple motor or sensory tasks that demand little processing of information (Organisation for Economic Co-operation and Development 1978). Some researchers report that marijuana appears to decrease behavior associated with risk-taking related to driving (Seppala, Linnoila, and Mattila 1979).

The combined use of alcohol and other drugs may be inferred from surveys of drug use patterns and has been confirmed by analysis of body fluid specimens from both fatally injured and impaired drivers (Joscelyn et al. 1979). Reeve (1979) reported results of analyses for delta-9-tetrahydrocannabinol in blood specimens from persons arrested for impaired driving in California; alcohol and marijuana use was evident in many of the cases studied. The combined effects of alcohol and marijuana, therefore, are of considerable interest to drug and driving research. Impairment of performance was greater with alcohol and marijuana than with either drug alone in laboratory tests (Manns et al. 1971; Burford, French, and Le Blanc 1974; Chesher et al. 1976). Both marijuana and alcohol delay glare recovery, a factor in night vision; their combined effects on this variable did not differ significantly from either drug alone, suggesting some antagonism between the drugs (Adams et al. 1978).

In summary, evidence from laboratory tests indicate that marijuana at certain dosages, alone and combined with alcohol and other drugs, impairs skills and behavior related to driving. Less numerous studies involving actual car handling generally support the implication that marijuana use by drivers can increase the likelihood of traffic crashes, especially in higher doses.

Other Drugs

Benzodiazepines: Diazepam (Valium®), Chlordiazepoxide, Flurazepam (Dalmane®), and Related Agents. Unlike marijuana or

preparations using delta-9-THC, which until recently have had no generally accepted medical use, the benzodiazepines (a chemical classification) are frequently prescribed for a variety of therapeutic reasons (Sellers 1978):

- acute anxiety states, chronic anxiety neurosis (antianxiety);
- continuous seizures, petit mal (antiepileptic);
- alcohol withdrawal;
- insomnia;
- neuromuscular disorders, backache, muscle trauma;
- psychosis, anxiety with depression, phobic disorders;
- amnestic therapy, sedation. (pp. 1533-1534.)

Similarity of effects among this class of drugs appears to outweigh differences arising from accepted use (Greenblatt and Shader 1975). Pharmacologically, they are depressants, with side effects that include drowsiness, lethargy, and loss of coordination.

Experimental studies of these drugs are most numerous for diazepam, followed by chlordiazepoxide (the oldest member of this group) (Kleinknecht and Donaldson 1975; Clayton 1976; Linnoila 1976; Joscelyn et al. 1979; Seppala, Linnoila, and Mattila 1979). As often noted in literature reviews, the use of different test procedures, drug doses, and drug regimens (e.g., acute, chronic administration) has led to diversity in findings and has reduced comparability among studies.

Kleinknecht and Donaldson (1975) reviewed twenty-three studies of the effects of diazepam on reflex speed, attention and vigilance, decision-making, psychomotor performance, and other groups of tests. In all but simple reflexive responding, some indications of impaired performance were reported, for example, on tests of vigilance, choice reaction time, and motor coordination. Other reviewers have concluded that other benzodiazepines used as antianxiety agents produce "only minor impairment of psychomotor skills" (Seppala, Linnoila, and Mattila 1979, p. 392). The combined effects of these drugs and alcohol may be of greater concern, since antianxiety drugs can further decrease performance impaired by alcohol (Moskowitz and Burns 1977; MacLeod et al. 1977; Palva and Linnoila 1978).

The chronic or repeated use of benzodiazepines, especially diazepam,

chlordiazepoxide, chlorazepate, and flurazepam, leads to accumulation of other drug-like agents in the body, called **active metabolites.** Elimination of these compounds is relatively slow, and after extended use the amount of active metabolites present can exceed blood concentrations of parent drugs (Sellers 1978; Dureman, Malmgren, and Norrman 1978). Both cumulative effects and the residual or "hangover" effects of benzodiazepines are associated with active metabolites (Saario and Linnoila 1976; Zimmermann-Tansella, Tansella, and Lader 1976; Clarke and Nicholson 1978). Alcohol consumed following use of these drugs as hypnotics may enhance these effects (Seppala, Linnoila, and Mattila 1979).

Nonbenzodiazepine Sedative and Hypnotic Drugs: Barbiturates and Similar Agents. Sedative and hypnotic agents share alcohol's ability to produce general, reversible depression of the central nervous system. Used for sedation and to induce or maintain sleep at night, barbiturate and nonbarbiturate drugs in this class overlap the use—and effects—of benzodiazepines (Organisation for Economic Co-operation and Development 1978, p. 58). In fact, part of the decreased use of these drugs has been attributed to increased use of flurazepam and, to a lesser extent, diazepam and chlordiazepoxide (Institute of Medicine 1979, pp. 48-52).

Laboratory studies have demonstrated the similarity of effects on performance by alcohol and barbiturates. Impaired thinking, lack of emotional control, aggressive behavior, motor incoordination, drowsiness, and decreased oculomotor functions result from their use (Sharma 1976). Residual effects the "morning after" have been observed (Borland and Nicholson 1975). As can be expected, barbiturates and other nonbenzodiazepine sedative hypnotics (e.g., glutethimide, methaqualone, chloral hydrate, ethchlorvynol) add to the effects of alcohol (Institute of Medicine 1979, pp. 20-31). Doses of these drugs associated with hypnotic use or abuse can and do impair skills related to driving (Organisation for Economic Co-operation and Development 1978, p. 60; Sharma 1977).

Stimulants: Amphetamine and Related Drugs, Cocaine, and Other Agents. Amphetamine, its derivatives, cocaine, methylphenidate (Ritalin®), and drugs with similar properties stimulate the central nervous system.

All the drugs mentioned in prior sections of this chapter, with the possible exception of marijuana (Hill et al. 1974), are classified as depressants. Their effects are associated with impaired performance in tasks requiring alert, coordinated use of psychomotor skills and mental capacity. Drugs that have the opposite effects—i.e., stimulation—may be expected to improve performance of driving-related skills. In general, this expectation is met (Weiss and Latus 1962; Hurst 1976). For example, performance decrements in a prolonged auditory vigilance task was reduced by dextroamphetamine (Bye et al. 1973). Dextroamphetamine also had positive effects on two tracking tasks requiring eye-hand coordination (Schroeder, Collins, and Elam 1974). Little, if any, research related to driving has been reported for cocaine; that coca leaves and cocaine enhance performance impaired by fatigue is known at least anecdotally and by animal studies (Byck and VanDyke 1977). More questions than answers persist concerning cocaine (Egan and Robinson 1979).

Concern over the use of stimulants by drivers stems not from their positive effects but possible indirect consequences. Their well-known enhancement of mood (euphoria) (Brown 1977; Smith and Davis 1977) might lead to risk-taking, but evidence is slight (Hurst 1976). The use of stimulants to reverse fatigue and drowsiness can result in sudden unconsciousness once stimulant effects subside, a clear risk for long-distance truck drivers who reportedly use "pep pills" (Wyckoff 1979, p. 64).

(This is an example of a category of drug-related driving impairment for which BAC-equivalents would be of no use. This category also includes the adverse effects of withdrawal from dependence-producing drugs such as narcotics and sedative-hypnotics as well as the decontrol of dangerous medical conditions resulting from inadequate dosages of therapeutic drugs such as the antiepileptics and some cardiovascular agents. Because impairment of driving performance is due to the

absence of effective amounts of these drugs, analysis of blood to obtain evidence of "driving under the influence of drugs" may be fruitless. For instance, many laboratories responsible for drug analysis use methods that detect, at best, therapeutic concentrations and, usually, higher than therapeutic concentrations of drugs. Measurement of subtherapeutic (or subeffective) concentrations of certain drugs, including stimulants, would indicate prior use. Collateral data on the driver and the type of crash would be required to infer driver impairment resulting from inadequate dosages or the effects of withdrawal.)

Other Controlled Substances. Other drugs listed in the schedules of controlled substances (21 CRF 1308) have been little studied for their effects on driving skills.

Gordon (1976) reviewed the influence of narcotic drugs on highwav safety and concluded that "the use of narcotics in and of itself does not present a hazard or exist as a significant factor in automobile driving" (p. 6). He cited studies that indicated patients stablized on methadone performed as well as control subjects on performance tests. Acute effects of strong analgesics and abrupt withdrawal in persons dependent on narcotics could, however, present a traffic safety hazard, (Seppala, Linnoila, and Mattila 1979). Proproxyphene (Darvon®) alone at therapeutic levels did not impair driving-related skills (Kiplinger, Sokol, and Rodda 1974). The deleterious effects of combining these depressant drugs with alcohol can be presumed.

Hallucinogens, excluding marijuana, include both botanical and chemical substances. As reviewers have noted, few systematic experimental studies have examined the effects of these drugs on driving-related skills (Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979). Gross impairment of perceptual performance by hallucinogens is well known (Wesnes 1977). For example, LSD reduced performance and impaired the ability of subjects in a learning and memory task (Orseni and Benda 1959). Parashos (1977) clinically analyzed the "state of drunkenness" produced by psilocybin, observing such effects as:

- perceived alterations of time and space;
- misinterpretation of environmental stimuli;
- body image distortions;
- alteration of visual and auditory perception;
- emotional changes;
- slowed reactions to environmental stimuli; and
- inability to attend and impaired concentration.

These kinds of effects would certainly impair driving ability. What is not known is how many users of hallucinogens attempt to drive while under their influence.

Developed for use as a "dissociative anesthetic" in man, phencyclidine (PCP), is a depressant with hallucinogenic side effects. PCP has since been placed in Schedule I of the Schedules of Controlled Substances along with its analogs and immediate precursors (21 CFR 1308.11[d]; 21 CFR 1308.12[e]). Now produced illicitly by clandestine laboratories for distribution as a "street drug," PCP has received increased attention as its abuse continues to rise (Petersen and Stillman 1978). Like hallucinogens in general, PCP produces an acute confusional state with low to moderate doses; unlike hallucinogens, high doses often cause severe neurologic and cardiovascular conditions resulting in coma (Sioris and Krenzelok 1978). Burns and Lerner (1978) report that most deaths attributable to phencyclidine are accidental, including traffic crashes. Luisada (1978) recommended that "medical examiners should consider toxicologic analysis for PCP in all deaths resulting from drownings, falls from high places, apparently avoidable accidents, and from attempts to contain violently assaultive subjects" (p. 252). This kind of epidemiologic research is needed more than experimental studies of PCP's effects on driving skills, the outcomes of which are predictable.

Other psychoactive drugs that are not controlled substances have received attention in the experimental literature related to drugs and driving:

- antidepressants;
- antipsychotics;
- antihistamines and cough and cold remedies;

- minor outpatient anesthetics;
- central muscle relaxants;
- antiepileptic agents;
- antidiabetic agents;
- cardiovascular drugs; and
- sex steroids.

A discussion of the effects of these drug classes is beyond the scope of this report; however, drugs in these classes do have the potential to impair driving. The reader is referred to other reviews that summarize literature pertaining to them (Seppala, Linnoila, and Mattila 1979; Joscelyn et al. 1979; Organisation for Economic Co-operation and Development 1978; Joscelyn and Maickel 1977a).

METHODOLOGICAL AND OTHER ISSUES

Earlier in this chapter, three general areas of experimental research on drugs and driving were singled out for comment:

- methods employed to test the effects of drugs on measures of performance believed related to driving;
- designs of experiments intended to demonstrate drug effects on driving-related skills; and
- the lack of realism in laboratory studies that limits extrapolation from their findings to actual driving impairment.

The following discussion identifies underlying methodological and other issues that hamper experimental drug and driving research, based on recent critical reviews that address these concerns (Clayton 1976; Joscelyn and Maickel 1977a; Willette 1977; Organisation for Economic Co-operation and Development 1978; Joscelyn et al. 1979).

A broad range of behavioral methods and techniques is used to measure drug effects. The diversity of tests and response measures, combined with the number and type of different drugs, has resulted in a body of knowledge that is not complete—and certainly not definitive—for any single drug. Table 3-1 indicates the variety of behavioral methods

TABLE 3-1

AN OUTLINE OF BEHAVIORAL RESEARCH METHODOLOGY AS APPLIED IN STUDIES OF DRUG EFFECTS ON DRIVING PERFORMANCE AND ON HUMAN SKILLS BELIEVED RELATED TO DRIVING

TYPE OF METHODOLOGY	EXPERIMENTAL SETTING	EXAMPLES OF TESTS, TASKS, AND BEHAVIORAL OR RESPONSE VARIABLES
ACTUAL DRIVING (Subject drives vehicle)	OPEN ROAD	Lane Position, Steering Wheel Reversals, Velocity (speed), Change in Velocity, Car Following Distance, Gap Acceptance
	CLOSED COURSE	Driving Maneuvers, Including Fender Judgment (e.g., parallel parking, gap acceptance), Chassis Set (e.g., vehicle handling), Curve Management, Obstacle Avoidance, Controlled Braking
SIMULATED DRIVING (Subject operates driving simulator)	BEHAVIOR LABORATORY Simple Driving Simulator	Tracking Task, Others (can measure visual perception, vigilance)
	Complex Driving Simulator (secondary tasks included)	Tracking and Search and Recognition Tasks, Measuring Visual Perception, Vigilance, and Rate of Information Processing
METHODS TO ASSESS HUMAN PSYCHOPHYSICAL FUNCTION	BEHAVIORAL LABORATORY	
Sensory-Perceptual		Kinetic Visual Acuity, Static Visual Acuity, Critical Flicker Fusion Frequency
Sensory-Motor		Simple Reaction Time (e.g., responses to visual or auditory stimuli)
Perceptual		Depth Perception, Sustained Attention (vigilance)
Perceptual-Motor		Choice Reaction Time, Complex Function Tracking, Eye Movements
Motor Skills		Hand and Body Steadiness, Ocular Motor Control, Tapping
METHODS TO ASSESS HUMAN PSYCHOLOGICAL FUNCTION	BEHAVIORAL LABORATORY	
Cognitive Skills		Digit Symbol Substitution Tests, Mental Arithmetic, Digit Span, Stroop Test
Mental Functions		Memory, Learning, Rate of Information Processing
Other		Motivation, Personality, Intelligence
METHODS TO ASSESS HUMAN PHYSIOLOGICAL FUNCTION	CLINICAL LABORATORY	
Physical Parameters		Electroencephalogram (EEG), Electrocardiogram (EKG), Galvanic Skin Response, Hormone Levels and Cycles, Motor Nerve Impulse Conduction

Source: Joscelyn et al. 1979, p. 78.

that have been employed in driving-related research on drug effects.

Appendix A summarizes methodological and other problems that also limit the usefulness of past experimental research on drug effects. Categories of problems include drug, human subject, technique or method, experimental design, and the reporting of research. Specific examples illustrate but do not exhaust critical assessments offered by reviewers. The consequences of deficiencies in experimental research are also described.

With respect to drugs under study, a major issue is that the ways drugs are commonly used differ greatly from how they are tested. For example, most people do not take a drug just once, but repeatedly over a period of time. Yet in most experiments the effects of a single dose are studied. The behavioral effects of acute drug doses may not represent the effects of the same drugs used chronically. With repeated, long-term use of drugs, either increased tolerance or increased susceptibility to a drug's effects may be observed. Other widespread patterns of drug use, such as excessive doses of both licit and illicit drugs, have been rarely studied. In particular, because the simultaneous use of two or more drugs (including alcohol) has become increasingly prevalent, more studies of the combined effects of two or more drugs are needed to estimate its impact on highway safety.

Another issue is that groups of human subjects selected for experimental research are not representative of populations that actually use the drugs under study. Major constraints on experimental research have been imposed by federal regulations concerning the use of human subjects. For example, restrictions on the use of female subjects of child-bearing age prevent investigators from studying the effects of some therapeutic drugs, such as antianxiety agents, in a significant portion of the driving population which uses these drugs. To enhance the relevance of driving-related research, human subjects should be representative. The perennial choice of subjects—normal, healthy, male college students--may be appropriate for studying the effects of marijuana, but not psychotherapeutic drugs prescribed mostly for men and women of middle age.

Other problems related to subject selection are frequently encountered in the experimental literature. Since medical conditions themselves can impair driving, and because psychoactive drugs prescribed to treat these conditions may actually improve driving ability, the use of patients as experimental subjects should occur more frequently than it does. In addition, the number of subjects in experimental studies is usually small; as a result, intersubject variability, a common phenomenon in drug research, renders many findings statistically insignificant. Some drug effects may be missed entirely. Not only the selection but also the control or monitoring of subjects during an extended study is neglected. The physiological and psychological condition of a subject over a period of weeks or even days may vary; one factor may be the use of other drugs.

Another major issue is that research to fully define the actual driving task has not been done. As a consequence, laboratory tests that reproduce the driving task do not exist. Needed are protocols that validly and reliably measure the effects of drugs on driving performance. Many current behavioral methods now used tap several skills—sensory, motor, perceptual, and cognitive--but nonspecifically. Since drugs can affect any or all of these, response measures may not indicate which skill was affected. If no effect is found, the possibility remains that subjects compensated for an impaired skill. Most studies based on simple performance tests use several tests; comprehensive testing of a full range of possible drug effects is rarely done. Consequences of this approach are (1) a lack of depth in the literature and (2) conflicting findings--some studies reporting both positive and negative changes in behavior, others reporting no effect. A few research groups have applied behavioral tests developed to measure a variety of behaviors and skills related to driving (Moskowitz, Hulbert, and McGlothlin 1976; Linnoila and Mattila 1973); these groups are exceptional, however, and do not represent the great majority of efforts reported in the literature.

To compensate for unavoidable limitations imposed by the present state of the art in behavioral methodology, strong experimental designs should be employed to maximize relevance to practical problems in highway safety. Unfortunately, most studies evidence weak designs that

prevent definitive statements about the risk potential of drugs. For example, many skills learned in driving become automatic with practice; these skills may be more resistant to the effects of drugs than behavioral tasks unfamiliar to subjects. In most experiments, however, baseline performance by subjects is not established, nor are they given sufficient opportunity to become practiced at assigned tasks.

The lack of realism in experimental research is further aggravated by infrequent and inappropriate times of testing. Most studies do not take into account that drugs differ greatly in their onset of action and in their duration of effects; peak effects of drugs also vary in time, between drugs, between different subjects, and even in the same subject on different days. Some drugs produce residual effects after their primary action has ceased (for example, the "hangover" effect). Because most studies do not investigate the full time course of drug effects, research remains incomplete, even though numerous reports on a single drug are published. Finally, important variables are not even measured--in particular, the concentrations of drugs in the body fluids of subjects. Hence, the relationship between the amount of drug present in a subject and the magnitude of its effects remain uncharacterized, a serious deficiency in research purporting to address informational needs in highway safety. Even in studies that do measure the body fluid concentrations of drugs, the small number of subjects and the infrequency of such measurement render the data obtained nearly useless for most practical purposes.

This discussion of issues in experimental research has emphasized some negative features of studies done to date. These comments, like those of other reviewers, are intended to serve more as guides to future research than as warnings against further attempts to study drug effects on driving-related skills. The need for quality research that provides answers to the many questions that remain in the area has never been greater. To continue collecting unrelated fragments that cannot answer these questions is pointless. Adequate experimental research is costly, but, well aimed, it can effectively serve as a rich source of needed information for highway safety.

ONGOING AND PLANNED RESEARCH

In addition to past studies of drug effects on human behavior and skills related to driving, ongoing and planned research was identified. Several methods were used:

- contacts with federal and state agencies that identified projects or programs sponsored by or known to them;
- contacts with organizations and researchers active in experimental research on drugs and driving;
- computer-based searches of federal information and retrieval systems that contain abstracts and other data concerning projects and grants; and
- manual searches of files containing information on recent contracts and other efforts maintained by the Highway Safety Research Institute Library.

The purpose of this effort was to assess present and near-future activity, its direction, and information on drug effects forthcoming in the next several years.

Federal Efforts. Federal agencies that identified activity related to drugs and driving were mainly in the U.S. Departments of Transportation, and Health, Education, and Welfare.

The National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, is currently sponsoring or partly funding several research efforts (Table 3-2). Laboratory tests of psychomotor skills, driving simulation, and car handling maneuvers are among the approaches used in these studies. One project is an interagency cooperative effort involving NHTSA, and the National Institute on Drug Abuse (NIDA). Conducted by the Southern California Research Institute, experiments will examine the relationship over time between the behavioral effects of selected drugs and their concentration in body fluids of subjects. According to one official in the NIDA, this series of studies (to be reported in detail by mid-1980) represents a first systematic attempt to correlate the amounts of drugs in the body with impairment

TABLE 3-2

SELECTED ONGOING AND PLANNED RESEARCH
ON THE EFFECTS OF DRUGS ON DRIVING-RELATED SKILLS

TITLE [OTHER DESCRIPTOR] (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Pharmacokinetic Effects of Drugs on Driving Performance (National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare)	National Highway Traffic Safety Administration, U.S. Department of Transportation. Contract DOT-HS-7-01651. TRAIS No. NH160681 (Interagency cooperative effort)	Pharmacokinetic relationships of selected drugs to specific driving measures are investigated using a driving simulator.
Pharmacokinetics of Drug Effects on Driving Performance (Southern California Research Institute)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-76-3316)	An attempt is made to study the pharmacokinetic relationships of selected drugs and their effects on specific driving and complex human performance tasks, such as perception, attention, and information processing.
Alcohol Effects on Driving, Perception, and Attention (Department of Psychology, University of California)	National Institute on Alcohol Abuse and Alcoholism, U.S. Department of Health, Education, and Welfare (R01 AA 00251-09)	This study attempts to determine the nature of alcohol-induced perceptual and cognitive deficits in the driving situation. It also attempts to examine the psychological processes underlying impaired perception. Finally, it examines the interactions of age, sex, and drinking history with alcohol effects on behavioral impairment. Combined drug and alcohol studies are also planned.
Sensitivity to Driving Impairment with Drugs of Abuse (Department of Psychiatry, Duke University School of Medicine)	National Institute of Drug Abuse, U.S. Department of Health, Education, and Welfare (R01 DA 01883-02)	Diazepam and pentobarbital, administered both orally and intravenously, are studied for their effects on psychomotor skills related to driving in normal, anxious, sedative-tolerant, and aged populations. The effects of marijuana and amphetamine on psychomotor skills related to driving are also examined, both with and without sleep deprivation.
Alcohol Intake Search Activity and Driver Performance (Department of Psychology, Washington University)	National Institute on Alcohol Abuse and Alcoholism, U.S. Department of Health, Education, and Welfare (R01 AA 00301-06)	The combined effects of alcohol, chlordiazepoxide, and diazepam on various parameters of complex psychomotor functioning are studied. Both the effects of a single dose of psychoactive medication in combination with alcohol, and the effects of chronic medication in combination with alcohol are studied, especially as they relate to visual search activity.

TABLE 3-2

SELECTED ONGOING AND PLANNED RESEARCH
ON THE EFFECTS OF DRUGS ON DRIVING-RELATED SKILLS (Continued)

TITLE [OTHER DESCRIPTOR] (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Effects of Alcohol and Marihuana on Driver Control Behavior (Systems Technology, Inc., Hawthorne, California)	National Highway Traffic Safety Administration, U.S. Department of Transportation (DOT-HS-5-01257)	Study emphasizes effects on heading and lateral path control, relating these effects to possible reasons for accidents. Methods include both driving simulator and in-vehicle testing.
Drug Abuse Clinical Research Program Jack Mendelson, McLean Hospital, Belmont, Massachusetts)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (P01 DA 001676)	Among a number of pharmacologic and behavioral studies will be one concerning polydrug abuse in humans. Measures of behavior related to driving are included.
Social Policy Toward Non-Medical Drug Use (William McGlothlin, University of California, Los Angeles)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (K05 DA 070182)	Study includes the effects of drugs (alcohol, marijuana, and methadone) on psychological functioning related to motor vehicle operation and develops a systems analysis of problems associated with drug control.
[Effects of Alcohol and Other Drugs, Singly and in Combination, Upon Driving-Related Skills] (Southern California Research Institute)	Insurance Institute for Highway Safety	A series of studies using a battery of tests that measure pursuit tracking, visual divided attention, visual backward masking, and other skills.
[Effects of Marijuana and Alcohol on Closed Course Driving] (Lawrence Sutton, Wellness Resource Center, University of Pittsburgh, PA)	(State and local funding)	The effects of different doses of marijuana and alcohol on three driving maneuvers. The combined effects of these drugs will also be investigated.

of driving-related skills. One contribution of this research will be a better understanding of the methodological problems involved in this area of study. Substantive--but not necessarily definitive—information on the drugs under study will be produced. Because small numbers of subjects are used, the establishment of "presumptive limits" equivalent to blood alcohol concentration (BAC) will not be possible. Some indication of intersubject variability will be gained, however.

Several federal agencies reported projects that pertain indirectly to drugs and driving. For example, the National Eye Institute currently supports a number of studies of drug effects on the human eye. A computer search provided by the National Eye Institute identified projects that are currently funded in this area. Visual performance is an important factor in driving, and this kind of research can be useful in assessing the potential of drugs to impair skills related to vision and perception. Of particular interest are ongoing studies of the visual effects of marijuana used in treatment of glaucoma. Not clear from the titles or abstracts of marijuana projects identified by the NEI or the Drug Enforcement Administration is the extent to which testing of visual performance will be related to driving per se.

Another computer search of alcohol and drug projects was made by the Veterans Administration for this report. Abstracts of projects selected from the VA Research and Development Information System revealed two projects concerned with human performance indirectly relevant to drugs and driving:

- Psychotropic Drugs and Flying Ability, VA, San Diego, California

  A study of the combined effects of marijuana and alcohol on mood, subjective state, and flying ability using a flight simulator. The interaction between lithium carbonate and both alcohol and marijuana was examined.

- Neuropsychological Assessment of Polydrug Abusers, VA, San Diego, California

  A pilot study of the effects of drug abuse on the brain, this project is a part of a larger polydrug demonstration project funded by NIDA. Perceptual-motor coordination,

accuracy of perception, and speed of motor movements are among the neuropsychological deficits under investigation.

Nonfederal Efforts

Experimental and clinical research related to drugs and driving but not federally funded was also identified.

At the University of Pittsburgh, a small demonstration project is planned. Using a closed driving course with defined maneuvers, the study will examine the effects of marijuana and alcohol, alone and in combination. Measurement of blood concentrations of both drugs are planned included as part of the work. A similar effort, as yet unfunded and in an early planning stage, was reported by a researcher at the University of Vermont. These efforts indicate that additional information on the effects of marijuana on measures of actual car handling may be available in the near future. It will supplement ongoing research sponsored by NHTSA.

Contacts with insurance and pharmaceutical companies and associations revealed some research directly or indirectly sponsored by industry. For example, the American Insurance Highway Safety Association, the American Insurers Highway Safety Alliance, the National Association of Independent Insurers Safety Association, and a number of insurance companies support research by the independent Insurance Institute for Highway Safety (IIHS). The IIHS is currently sponsoring a series of studies at the Southern California Research Institute on the effects of alcohol and other drugs on driving-related skills (see Table 3-2). A report covering work under the IIHS grant has been published (Moskowitz and Burns 1977). Direct contacts with insurance company representatives identified no research efforts other than that sponsored by IIHS. Interest in funding additional research and other activity in drugs and driving was indicated by some companies.

Pharmaceutical companies contacted by telephone and letter reported substantial activity related to the study of psychoactive drug effects. Most described a general approach to evaluating a drug's safety and

efficacy:

- a battery of screening tests to determine its pharmacological properties in animals, with any adverse effects recorded to alert investigators during subsequent clinical trials, if performed; and

- clinical assessments by physicians, along with physician and patient rating scales, with adverse behavioral changes and other adverse reactions assessed for frequency and severity.

Most representatives of pharmaceutical companies indicated that no specific procedures or methods were used to quantitate behavioral effects related to driving. Some said that clinical observations were sufficient to identify drug effects that might impair driving or operating heavy machinery. These observations, combined with known properties of a drug, for example, sedation, become the basis for warning or precautionary statements included in a drug's label. Others questioned the need for driving-related studies during premarket testing, since for most psychoactive drugs these statements would have to be included anyway.

Other pharmaceutical companies, however, reported ongoing and planned studies concerning the effects of new and old drug products on human behavior and skills specifically related to driving. For example, Hoffmann-La Roche, Inc. has funded a study at the Duke University School of Medicine that will compare the effects of diazepam in normal subjects and in highly anxious patients both with and without medication. This research will attempt to determine whether this therapeutic agent actually improves driving-related performance of persons with a condition that may itself impair driving skills. In addition, Hoffmann-La Roche is planning a program on the effects of hypnotics and other psychotherapeutic drugs on measures of performance.

Hoechst-Roussel Pharmaceuticals, Inc., has been studying the effects of its psychotropic drugs on performance in volunteer subjects and patients both in the U.S. and abroad (e.g., Wittenborn et al. 1979; Biehl 1979). Although no uniform approach has been established, efforts to evaluate drug effects on driving-related behavior include laboratory tests (attention and memory, psychomotor performance, and perception), driving

simulation, and actual motor vehicle driving on closed course and real traffic situations.

Lederle Laboratories of the American Cyanamid Company recently sponsored a special clinical trial of a new antidepressant drug. Using tests of reaction time, visual motor coordination, and depth perception, the drug was compared to amitryptyline and interactions with alcohol were measured. Abbott Laboratories and Merck Sharp and Dohme cited past studies of drug effects on driving-related performance but indicated no current or planned efforts in this area.

The ongoing and planned research described above--both federally and nonfederally sponsored--was reported by agencies, organizations, and individuals contacted directly for this information. The search and review of literature summarized earlier in the chapter indicate that studies of drug effects on human performance are ongoing in many universities and other research centers. Undoubtedly, many research efforts not identified in this study are both ongoing and planned. Interest in the behavioral effects of psychoactive drugs, especially effects on safety-related skills, appears to have increased over the past ten years. No indications that this interest has diminished were found.

SUMMARY

The purpose of experimental research is to assess the potential of drugs to increase the likelihood of traffic crashes and associated losses. The study of drug effects on human behavior and skills related to driving includes the combined effects of drugs, including alcohol. Past research, however voluminous, has not fully answered basic questions concerning the adverse effects of drugs on driving performance. The present limited state of knowledge is due primarily to the lack of systematic, in-depth, coordinated efforts and to the number of psychoactive drugs of interest, both licit and illicit. Past research has established that many drugs, alone and combined with alcohol, can impair driving-related skills measured by laboratory tests and in-vehicle driving tasks. Nevertheless, methodological and other issues persist in this area, rendering these findings highly suggestive but not definitive. Among these issues, the

questionable validity of laboratory and other tests is most problematical. Chronic weaknesses in experimental designs and the selection of subjects not representative of drivers who use the particular drugs further decrease the relevance of experimental research to practical problems in highway safety. Ongoing and planned efforts identified by agencies and researchers include comprehensive studies that may lead to increased knowledge about drug effects and their potential to increase highway safety risk.

CHAPTER FOUR

EPIDEMIOLOGIC RESEARCH

Epidemiology in drugs and highway safety seeks to answer two basic questions:

- Does the use of drugs other than alcohol in the general driving population increase the likelihood of traffic crashes and associated losses?
- What is the role of drugs as contributing factors in traffic crashes? That is, what behaviors or errors are associated with the use of drugs by drivers responsible for traffic crashes?

The overall aim of epidemiologic research is to identify targets for countermeasure action—specific drugs, subpopulations of drivers who use drugs, etc. This section:

- briefly summarizes the state of knowledge in this area of research;
- highlights past research, emphasizing recently completed studies;
- describes ongoing and planned research as well as related data collection efforts; and
- identifies issues pertaining to methodology and research design that must be addressed in future research.

THE STATE OF KNOWLEDGE

Recent reviews of past research on the use of drugs by drivers—and consequences of use—indicate that studies done to date do not provide definitive answers to the questions above (Joscelyn and Maickel 1977a; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979; Joscelyn et al. 1979). In fact, all reported studies appear to have limitations that allow only the most guarded

conclusions. Problems related to methodology and research design abound; findings of drugs in small, nonrepresentative groups of drivers cannot be generalized.

The following statements reflect a general consensus of the state of knowledge.

- Research has confirmed the presence of drugs in both driving and accident populations. Only rarely have roadside surveys or studies of injured drivers been done.

- No studies, large- or small-scale, have used the approach by Borkenstein et al. (1964), comparing a representative sample of crash-involved drivers with a suitable control sample from the general driving population.

- Few efforts have yet been made to determine driving behaviors or errors, accident characteristics, or driver responsibility for traffic crashes associated with the use of drugs. In rare instances, high concentrations of drugs in driver body fluids have been measured, strongly suggesting gross impairment as a causal factor in these crashes.

Existing data, therefore, do not describe a strong association between drugs and traffic crashes, but neither does published research, limited as it is, dismiss drugs other than alcohol as a source of concern in highway safety.

A comparison of the present state of knowledge concerning alcohol and other drugs and highway safety shows that drug and driving research is now where alcohol and driving research was **over forty years ago.** Then for alcohol as now for other drugs, little if any research had demonstrated that drinking drivers who were legally impaired were more likely to be involved in traffic crashes than sober drivers. Then too, chemical tests for alcohol had just entered the field. Presently, only known patterns of other drug usage along with knowledge of drug effects on human behavior support the premise of a substantial drug and driving problem--the same impetus that gave rise to efforts dealing with the alcohol-crash problem.

Adequate epidemiologic research to confirm the implications of laboratory studies remains undone. Nevertheless, criticism of past

research should be balanced by reference to underlying constraints confronting researchers in this difficult area (Joscelyn and Donelson 1978). **Because research is very limited, generalizations beyond the groups of drivers studied lack scientific credibility and should be discouraged.**

These notes of caution address a tendency to seize upon findings of infrequent reports of drugs in drivers and to apply them in support of preconceived positions on the subject. These comments are not to suggest that few drivers are impaired by drugs other than alcohol, nor to imply that efforts to deal with drug impaired drivers should cease. What **is** emphasized is that a **national** drug and driving problem has not been defined and that the present state of knowledge does not seem to warrant vast, new expenditures probably required to deal effectively with this problem. As Joscelyn et al. (1979) pointed out:

> The dilemma is circular, of course. The area of drugs and driving is not a priority concern in highway safety because present data do not show that drugs other than alcohol are overrepresented in traffic crashes. Lacking priority, drug and driving research has not received the level of funding required for definitive studies. (p. 55.)

Although a national drug and driving problem has yet to be defined, in local jurisdictions where a problem has been identified, throughtful and prudent programs aimed at drug-impaired drivers are appropriate. Also appropriate now is federal support for state and local efforts to detect drug use by motor vehicle operators, especially impaired drivers. These efforts would not only lead to the apprehension of persons who violate driving-under-the-influence-of-drugs (DUID) laws, but would also supplement epidemiologic research with data that indicate the nature and extent of the problem.

EPIDEMIOLOGIC RESEARCH FINDINGS

Studies of drug use among driving populations, both at-risk and crash-involved, have used three basic approaches:

- questionnaires that obtain data on the frequency of drug

use among drivers, driving while using drugs, and accidents or violations occurring while using drugs;

- analysis of drivers' body fluids for the presence and amount of drugs; and
- examination of driving records of known users of drugs.

Research using each approach has been reported; rarely have two or more of these been combined in a single study. This section briefly summarizes past epidemiologic research on drugs and driving.

Recent reports have reviewed past studies and provide a basis for the following discussion (Joscelyn and Maickel 1977a; Willette 1977; Organisation for Economic Co-operation and Development 1978; Seppala, Linnoila, and Mattila 1979; Joscelyn et al. 1979). Epidemiologic research published since has been identified in the literature search task and is reviewed below to update those reports. Information received from contacts with agencies at the federal, state, and local levels has been included as well. For the most part, this new information is data obtained in the course of daily operation of enforcement agencies or offices of medical examiners and coroners. To the extent data are compiled and reported, these sources of information supplement the findings of formal research projects. Because the selection of eligible cases is incomplete or biased from a scientific perspective, these data are indicative of the magnitude of a drug and driving problem but do not reliably define the problem. The lack of current information on drug use among drivers makes these limited data valuable although they do not support general statements.

Marijuana

Until recently, the lack of chemical tests for delta-9-tetrahydrocannabinol and other constituents of marijuana limited surveys to questionnaire or driving record approaches. Studies using questionnaires have found that many users of marijuana report driving after using it. For example, Smart (1974) reports that about one-fourth of a college student sample drove after marijuana use; Jaeger, Fleming,

and Appenzeller (1975) reported 17.4% in a sample of 488 licensed drivers aged 16 to 49. Sterling, Smith, and Graham (1976), using indirect information obtained about drug use two hours before a fatal accident, concluded that 16% of 267 drivers judged responsible for the accident were under the influence of marijuana. These and other studies that rely on self-reported drug use or other similar information indicate that drivers do drive after using marijuana; however, their findings are inconclusive due to the low reliability of such sources of data.

The recent development and application of chemical tests for marijuana use among drivers has permitted more direct studies. Midwest Research Institute developed a method for detecting marijuana use in studies of drug use among fatally injured drivers (Woodhouse 1974) and drivers stopped at roadside (Glauz and Blackburn 1975), sponsored by NHTSA. The method, which involved hand and nasal swabs followed by thin layer chromatography, was of questionable reliability, and other substances may have led to false positives (Glauz and Blackburn 1975, p. v). Teale and Marks (1976) published a report describing a single driver fatality in whom high concentrations of cannabinoids were measured by radioimmunoassay, a more specific and sensitive technique. No alcohol was found. Teale et al. (1977) also reported a study of sixty-six drivers fatally injured in traffic crashes in 1976 and 1977; they detected marijuana (or hashish) use in six of these drivers (9%); one of these drivers had also used alcohol.

As noted in Chapter One, a draft of this report was submitted to NHTSA to support the preparation of a report to Congress by the Secretary of Transportation (1979). In preparing the final report, a more detailed analysis of a recently reported marijuana and driving study (Reeve 1979) was completed.

Reeve reported chemical test results for delta-9-tetrahydrocannabinol (THC) in blood from persons arrested for impaired driving. Hemolyzed blood specimens obtained by the California Highway Patrol were analyzed by a radioimmunoassay procedure specific for THC. A "marijuana-positive" case was defined as a blood specimen containing 5 nanograms of THC per milliliter of blood, the reported detection limit of

the assay. (A nanogram is one billionth of a gram.) Given present uncertainty over the meaning of low concentrations of THC for driver impairment, positive results for THC cannot be interpreted to mean that the drivers were impaired by marijuana. Table 4-1 summarizes findings reported by Reeve.

Reeve reported that a total of 1,792 specimens were analyzed for alcohol and THC. Of the 1,792 specimens, 1,507 tested positive for alcohol and 285 tested positive for THC. The specimens included in the study came from two groups of drivers arrested for impaired driving: (1) 1,027 drivers whose BAC was 0.10% w/v or less; and (2) 765 drivers whose BAC was greater than 0.10% w/v, the legal limit in California. Reeve reported that 45 of the 1,792 specimens tested positive for THC alone; the remaining 240 THC-positive specimens also tested positive for alcohol, with 111 having greater than 0.10% w/v BAC, the presumptive limit for impairment. These findings complicate any interpretation concerning impairment by marijuana.

The interpretation of these findings is further complicated by other data reported by Reeve. For example, according to Table 17 of that report (p. 75), 242 of the total of 1,792 specimens were analyzed for other drugs in addition to alcohol and THC. In 92 (or 38%) of these 242 specimens, other drugs were detected, including barbiturates, sedative-hypnotics, tranquilizers, "other" (unspecified) drugs, and drugs in combination. The report does not indicate how the 242 specimens were selected for analysis, but 236 of these contained 0.10% w/v BAC or less. Twenty-nine specimens that were THC-positive and contained 0% w/v BAC were analyzed for other drugs in addition to alcohol and THC; 13 of the 29 specimens contained other drugs. While these figures cannot be extrapolated to the California impaired-driving population, they do suggest that polydrug use is common. These findings emphasize that future studies should not focus on a single drug but rather analyze each body fluid specimen for a set of drugs of interest.

These problems and other data reported by Reeve indicate that great caution is required in interpreting the meaning of study findings. For example, the largest percentage of specimens positive for THC were from

TABLE 4-1

THE DETECTION OF DELTA-9-TETRAHYDROCANNABINOL IN HEMOLYZED BLOOD SPECIMENS FROM PERSONS ARRESTED FOR IMPAIRED DRIVING
(Prepared from Data Reported by Reeve [1979])

BLOOD ALCOHOL CONCENTRATION	NUMBER OF DRIVERS	NUMBER OF DRIVERS WITH POSITIVE THC(%)
Subgroup 1: Specimens Containing 0.10% w/v Blood Alcohol Concentration or Less		
0	185	45 (24%)
.01 - .05% w/v	222	35 (16%)
.06 - .10% w/v	620	94 (15%)
TOTAL	1027	174 (16.9%)
Subgroup 2: Specimens Containing Greater Than 0.10% w/v Blood Alcohol Concentration		
.11 - .17% w/v	312	53 (17%)
.18 - .23% w/v	307	37 (12%)
.24 - .50% w/v	146	21 (14%)
TOTAL	765	111 (14.5%)

drivers aged 40 to 61 years; moreover, 13.6% of specimens from drivers aged 62 to 99 years were THC positive. This is a pattern of usage at great variance with the patterns of marijuana usage reported by numerous questionnaire-based surveys. Given the present state of the art in analytical methods for THC--and because hemolyzed blood is a highly complex and difficult specimen to analyze--the possibility that some portion of THC-positive findings represents **false** positives must be considered.

The California study as reported by Reeve (1979) has serious methodological flaws. Moreover, the presentation of findings in that report is misleading and, at places, inaccurate. For example, the report states that the 765 specimens with a BAC greater than 0.10% w/v BAC were "randomly sampled" from a population of approximately 19,000 (p. 17). Table 11 (p. 65) presents data on the month of incident leading to specimen collection. The number of specimens per month is totally inconsistent with a random sampling approach. Thus, the claim of the report that a random sample was obtained is likely to be untrue. Of greater concern are the report's implications and assertions. One example is the statement that "the most significant statistic that developed in this study was the 16 percent overall incidence of delta-9-THC in the California impaired driving population" (p. 5). A lay reader (e.g., Mann 1979) might interpret this to mean that 16% of all impaired drivers in California are impaired by marijuana. In fact, less than 2% of the specimens from the 1,792 drivers were positive for THC alone. Even ignoring the presence of drugs other than alcohol and THC, the figure of 16% stressed by Reeve (rounded from 15.9%) is composed of 2.5% specimens positive for THC with 0% w/v BAC; 7.2% specimens positive for THC with 0.10% w/v BAC or less; and 6.2% specimens positive for THC with greater than 0.10% w/v BAC. **The inference that 16% of the impaired drivers included in this study were impaired by marijuana is not substantiated.** In fact, the group of 1,792 specimens is not representative of any impaired driving population.

Even combining analytical findings for the two groups of impaired drivers to obtain the figure of 16% is improper. The 1,027 specimens with

0.10% w/v BAC or less ("every sample that could be obtained was analyzed," p. 17) and the 765 specimens with greater than 0.10% w/v BAC (unknown selection criteria) are from two distinct populations of impaired drivers. According to Reeve (1979, p. 17), the group of 1,027 specimens is from a population of less than 1,500 impaired drivers per year; the group of 765 specimens is from a population of approximately 19,000 submitted annually by the CHP. Because neither group of specimens can be considered representative of their respective populations, there is no valid way to combine the analytical results.

In summary, the study reported by Reeve (1979) has serious methodological flaws and some of the conclusions are not supported by the data presented. Nevertheless, the California study reported by Reeve (1979) is important for two reasons. First, it indicates that some impaired drivers use marijuana, although the magnitude of a marijuana and driving problem cannot be estimated from its findings. Second, that study highlights the need for careful, well-designed surveys that will permit valid statements about the prevalence of marijuana use in driving populations. This area of investigation--marijuana and driving--is extremely data-poor and problem-rich. At the same time, the broader issue of marijuana use in society is highly charged with emotion and polemic points of view. Fragmentary studies of marijuana use among drivers have been--and will continue to be--seized upon to support positions taken by one or other sides of these issues (e.g., Mann 1979). It is incumbent upon policymakers to scrutinize closely all such studies, to measure their contribution to the state of knowledge, and to assess their limitations. It is incumbent upon researchers to design, conduct, and report studies that meet accepted standards of scientific inquiry.

At present, data are not available to support a national assessment of marijuana's role in traffic crash causation.

Other Drugs

Benzodiazepines. This group of drugs includes antianxiety (e.g., diazepam [Valium®], or chlordiazepoxide) and sedative-hypnotic agents

(e.g., flurazepam [Dalmane®]). Most members of this drug class also have metabolites that are pharmacologically active (see Chapter Three). Like THC after marijuana use, benzodiazepines are present in minute amounts after use. Early surveys based on analysis of body fluids did not employ methods sensitive enough to detect therapeutic levels of these compounds (Finkle, Biasotti, and Bradford 1968; Blackburn and Woodhouse 1977). Advances in and increased availability of more sensitive analytical techniques have resulted in reports of benzodiazepine use among accident and nonaccident drivers.

Garriott and Latman (1976) found that 24 (18%) of 135 drivers arrested for driving under the influence of drugs (DUID) in Texas had used either diazepam or chlordiazepoxide. In a similar population from California, Lundberg, White, and Hoffman (1979) detected diazepam (171 times) and chlordiazepoxide (56 times) in a total of 765 cases. In both these studies, multiple drugs were frequently found in a single specimen. Among fatally injured drivers in Dallas County, Garriott et al. (1977) found 13 cases involving diazepam or diazepam plus alcohol in 127 drivers included. Bo et al. (1975) found 7 out of 74 injured drivers positive for diazepam compared to 4 of 204 nonaccident drivers; another 8 injured drivers had used both ethanol and diazepam. This study is significant in that some attempt to compare accident and nonaccident drivers was made. As Appendices B and C show, very few such comparisons have been attempted.

Nonbenzodiazepine Sedative and Hypnotic Drugs: Barbiturates and Other Similar Agents. Techniques for the analysis of barbiturates and other nonbenzodiazepine sedative and hypnotics have been available for many years. Most if not all studies involving the detection and quantitation of drugs in body fluids have included their analysis. Their frequency of occurrence has varied from study to study, depending on how drivers were selected; on the methods used to detect the presence of these drugs; and on the body fluid analyzed. For example, Turk et al. (1975) found only 2 cases involving sedative-hypnotic drug use among 171 fatally injured drivers; Garriott et al. (1977) found a slightly higher

percentage of cases among a similar group of drivers. White et al. (1979) found a much higher percentage of sedative and hypnotic drugs--even excluding benzodiazepines--in 1,819 drivers arrested in 1978 for driving under the influence with a blood alcohol concentration less than 0.10% w/v. Unfortunately, these and other studies lack reference to suitable control samples of drivers who have not crashed or who have not been arrested for impaired driving. The meaning of these percentages remains unclear.

Other Controlled Substances. Amphetamine, related stimulants, hallucinogens, and narcotic drugs generally are present in blood in extremely small amounts. Methods employed in most studies would not detect their use if only blood specimens were analyzed. Their presence in urine is indicative of use, but not necessarily of effect. Occasional findings of these drugs in some studies (e.g., Garriott and Latman 1976; Berg et al. 1971) probably reflects the limitations of analytical methods rather than their true prevalence among drivers. The continued development and application of relatively simple and highly sensitive assays of these classes of drugs will undoubtedly provide better estimates of their frequency of use among different driving populations.

Findings Reported by Agencies That Analyze for Drugs in Drivers

Direct contact with police, medical examiners and coroners, and toxicologists revealed that many agencies analyze body fluid specimens of drivers for drugs. Of seventy-one agencies contacted throughout the United States, forty-nine had some activity in this area; the remaining twenty-two indicated that they only performed chemical tests for blood alcohol concentrations. The forty-nine agencies that have been active included:

- offices of medical examiners and coroners,
- state health laboratories,
- police departments, and
- private analytical laboratories.

Chapter Five describes in detail who was contacted and what information

was received; data pertinent to the prevalence of drugs in different driving populations are summarized below.

The agencies contacted indicated that body fluid specimens from two groups of drivers were analyzed for drugs: drivers fatally injured in traffic crashes, and drivers arrested for driving under the influence. Typically, blood specimens from arrested drivers that had a blood alcohol concentration (BAC) lower than the legal limit (generally less than 0.10% w/v) were tested for other drugs. Table 4-2 summarizes information on drugs most frequently detected as reported by forty-two responding agencies. Some agencies indicated that statistics related to findings of drugs in drivers were not compiled; constraints included existing workload, limited personnel, and lack of sufficient funding. Some of these agencies did respond by naming drugs or classes of drugs most often detected, but these responses were based on judgment and not on actual data.

Of the forty-two agencies, ten analyzed body fluids of both fatally injured and arrested drivers. In addition, when asked to name drugs or classes of drugs most frequently detected, some gave two or more responses. The type of response ranged from very general classes (for example, sedative and hypnotic agents) to specific drugs (for example, diazepam). A simple classification scheme used in Table 4-2 summarizes all responses, whether general or specific.

As indicated by Table 4-2, depressants are most frequently detected both in deceased and in arrested drivers. The finding that more agencies analyze the body fluids of fatally injured drivers reflects current enforcement practices in the United States (see Chapter Six). Overall, agencies reported finding sedative and hypnotic agents and tranquilizers, especially minor tranquilizers (antianxiety agents), most often. Of specific drugs, diazepam (Valium®) was identified most often for both groups of drivers.

Some drugs and classes of drugs identified by agencies are not controlled substances (for example, antidepressants, antihistamines). **It should be noted that no agency indicated that any drug or class of drugs was detected more often than alcohol.** Table 4-3 presents findings on the percentage of specimens positive for alcohol or other

TABLE 4-2

DRUGS AND DRUG CLASSES REPORTED AS MOST FREQUENTLY DETECTED IN DECEASED AND ARRESTED DRIVERS

DRUG OR DRUG CLASS	DECEASED DRIVERS * (39 Agencies)	ARRESTED DRIVERS * (13 Agencies)
Sedatives and Hypnotic Agents	3	1
barbiturates	10	6
phenobarbital	1	
methaqualone	2	1
Tranquilizers	2	1
Minor Tranquilizers, Antianxiety Agents	7	4
diazepam	6	2
chlordiazepoxide	1	
Opiates, Related Agents	1	1
propoxyphene	4	
codeine	1	
Stimulants	1	
cocaine	1	
Antidepressants	1	
amitriptyline	2	
marijuana	1	
Antihistamines	3	
phenytoin (an Anticonvulsant)	1	1

* Number of times drug or drug class was reported as being detected.
Note: Not all agencies tested for all drugs or drug classes.

TABLE 4-3

COMPARISON OF REPORTED FREQUENCIES OF
ALCOHOL-POSITIVE AND OTHER DRUG-POSITIVE SPECIMENS

PERCENTAGE OF ANALYZED SPECIMENS POSITIVE FOR	ALCOHOL	OTHER DRUGS
1- 5		11
6- 10		3
11- 15		4
16- 20		2
21- 25		1
26- 30		3
31- 35	2	
36- 40	1	
41- 45	1	
46- 50	6	
51- 55	1	
56- 60	4	
61- 65	1	
66- 70	2	
71- 75	3	
76- 80	4	
81- 85	2	
86- 90	3	
91- 95		
96-100	1	

drugs as reported by the agencies contacted. Thirty-one agencies were able to estimate the percentage of specimens positive for alcohol; twenty-four could estimate the percentage of positive specimens analyzed for other drugs. Most agencies indicated that many more specimens were analyzed for alcohol than for any drug. In addition, the finding of two (or more) drugs in a single specimen was frequently reported as a confounding factor in this comparison. One forensic toxicologist remarked that the detection of a single drug was becoming a rarity in his jurisdiction.

METHODOLOGICAL AND OTHER ISSUES

Epidemiologic research to define a national drug and driving problem requires costly, complex studies that associate the use of drugs by drivers and traffic crashes. Various approaches, described earlier in this chapter, have been used. Problems with each approach have limited the value of information collected to date.

Examining driving records of persons known to use certain drugs is a very indirect and unreliable indication of a drug and driving problem. Methods of subject selection have resulted in comparison populations that are inappropriate (Maddux, Williamson, and Ziegler 1975). Groups of subjects carefully matched on some variables still have limitations. Poor driving records may stem from causes underlying both drug use and traffic crashes or violations. The probable use of two or more drugs, especially alcohol, complicates the simplistic labelling of persons as narcotic or marijuana users. Moreover, whether an accident or violation occurred under the influence of drugs remains unknown.

Surveys based on questionnaire are more direct. Information about the drug use and driving experience of those interviewed can be obtained. In most studies, however, samples of convenience are chosen, preventing inferences to the general driving population. General limitations of this approach include the unknown reliability of self-reports by subjects; self-reports unverified by analysis of body fluids (e.g., interviews with injured drivers); and low estimates due to demonstrable underreporting due to fear of prosecution or faulty memory.

The most direct approach involves chemical analyses of blood specimens obtained from drivers representative of various driving populations. Analysis of other body fluids, such as urine or saliva, may indicate drug use; given the present state of knowledge, however, the effects of drugs cannot be reliably inferred from amounts of drugs in these specimens. Issues and constraints associated with obtaining blood specimens for analysis differ according to the group of drivers under study. Table 4-4 lists methodological and other issues present in this kind of research.

Medical examiners, coroners, and, in some jurisdictions, police agencies obtain specimens of blood from fatally injured drivers and analyze for alcohol and (much less often) for other drugs. Research studies in which these agencies have cooperated have been conducted (Woodhouse 1974). Some medical examiners and toxicologists have routinely examined traffic crash fatalities for the presence and amount of alcohol and other drugs (Sunshine et al. 1968; Turk, McBay, and Hudson 1974; Garriott et al. 1977). Analytical methods used by these different laboratories differed, and interstudy comparisons cannot be made.

Research on the prevalence of drugs among **injured** drivers also is problematical. Issues include obtaining the full cooperation and support of hospitals and the informed consent of subjects. Potential problems include the frequent refusal of injured drivers to cooperate with the study and the unwillingness of emergency departments to participate in research. Perhaps due to these and other problems, studies of drugs among injured drivers are extremely few in number, an obvious gap in research on fatally injured and impaired driving populations.

A constraint on epidemiologic research has been the interpretation of federal regulations that has in the recent past restricted the Department of Transportation from conducting roadside surveys of drug use among drivers. Without such studies, comparisons between accident and nonaccident driving populations are difficult, if not impossible. As a consequence, the meaning of findings from crash-involved or impaired drivers will remain unknown.

Other major methodological issues in epidemiologic research stem from

TABLE 4-4

METHODOLOGICAL AND OTHER ISSUES IN EPIDEMIOLOGIC RESEARCH ON DRUGS AND DRIVING

PREVALENCE OF DRUGS IN DRIVERS' BODY FLUIDS

- Deficiencies in Study Design
  - nonrepresentative groups of drivers studied, including nonrandom sampling, samples of convenience, and drivers selected based on unknown criteria.
  - invalid comparisons between accident-involved and general driving populations including use of inappropriate statistical methods.
  - lack of suitable control samples from the general driving population at risk.
  - studies are of limited geographical scope.
  - additional data on drivers and crashes not obtained to aid in interpreting analytical results.
- Deficiencies in Method:
  - methods to detect and to quantitate drugs in blood inadequate or unavailable.
  - limited range of drugs screened in blood.
  - specimen collection and handling procedures not standardized, a potential source of error.
  - data analysis and interpretation lack rigor.
- Other Issues:
  - low compliance among subjects surveyed at roadside introducing probable bias.
  - random sampling procedures combined with small numbers of cases detect few cases for any given drug.
  - lack of accurate information about patterns of drug use in different regions and localities, making problematical the design of national drug and driving surveys.

the fact that most drugs are used by substantially fewer people than alcohol. Moreover, traffic crashes themselves are relatively rare--though costly--events. Traditional approaches to the study of drug-involved traffic crashes, therefore, may require very large sample sizes (at an unacceptable cost) to achieve a statistically significant result. Alternative approaches may be needed to obtain comparison groups for establishing drugs other than alcohol as factors in traffic crash risk.

The interpretation of analytical results remains a significant barrier to defining the drug and driving problem. For example, in cases of multiple drug use, no single substance may be present in concentrations indicative of impairment. Yet, when all drugs present are considered, their combined role in contributing to a traffic crash might be inferred. Nevertheless, little definitive information is available to substantiate that inference. In other cases, the presence of an impairing medical condition along with an appropriately prescribed drug in therapeutic amounts may be found. Although in normal subjects adverse side effects may be observed experimentally, the possibility exists that the drug may have reduced driver impairment due to the medical condition, though not sufficiently to prevent arrest for impaired driving. Attributing driver impairment to the therapeutic drug in these kinds of cases may be in error.

These problems indicate (1) the importance of collateral data in epidemiologic research to aid in the interpretation of chemical test results as well as (2) the need for further experimental research to establish, if possible, the meaning of drug concentrations in body fluids. This research should employ subjects representative of those in the driving population who use the drugs under study.

ONGOING AND PLANNED RESEARCH

In addition to completed work published in the literature and information on past activity obtained through contacts with federal and state agencies, ongoing and planned research was identified. Also identified were efforts that are not formal, scientific studies, but that will collect data on the presence and amounts of drugs in drivers.

Information on these kinds of activities was obtained exclusively through direct contact with federal, state, and local agencies. In a few instances, written documentation that described in more detail ongoing and planned efforts was also received.

Types of identified activity include the following:

- research and development of methods or techniques to study patterns of drug use (or abuse) in drivers or driving-age populations;
- surveys of drug use among drivers or driving-age populations; and
- collection and compilation of data by enforcement and other agencies that indicate the prevalence of drugs in driving or crash populations.

Methodology to support epidemiologic research on the patterns and consequences of drug use in general, and on drugs and driving in particular, has been a joint concern of both the National Highway Traffic Safety Administration (NHTSA) and the National Institute on Drug Abuse (NIDA). For example, NIDA has in the past supported efforts to develop designs and strategies for data analysis in research on substance abuse (Bentler, Lettieri, and Austin 1976). This agency has also supported the development of survey instruments for psychosocial research, at least one of which contains questions related to drug use and driving (Nehemkis, Macari, and Lettieri 1976). NHTSA and NIDA have funded research and development of analytical methods to analyze for drugs in body fluids. Activity in this area is described in Chapter 5. Staff in both agencies indicated that these activities would continue and can be considered ongoing.

The main emphasis of this section, however, is on activity that pertains directly to the relationship between the use of drugs in drivers or driving-age populations and highway safety. The purpose of this section is to indicate the kind of information on drugs and driving that can be expected in the next few years.

Surveys of Drug Use Among Drivers or Driving-Age Populations

Ongoing or planned research concerning drugs and driving usually involves one of two general approaches:

- questionnaires or interviews to obtain information self-reported by subjects; and
- collection and analysis of body fluids for the presence and amount of drugs.

Table 4-5 lists projects that relate wholly or in part to drugs and driving. In the first four studies, the relationship between drug use and highway safety is incidental to the main focus of each research effort. The continuing series of surveys of drug use among high school students, however, is of particular interest. It includes questions concerning drugs and driving and represents a potential source of information on patterns of drug use and its consequences related to highway safety. According to a project official, these data have not yet been analyzed. NIDA staff have advised that similar questions will be included in the 1979 National Survey on Drug Abuse, also sponsored by this agency.

The final three projects involve the analysis of body fluids for the presence and amounts of drugs. The Survey of Drug-Related Casualties was planned to include traffic fatalities as a subset of a larger group of accident victims. The other projects represent efforts to define the drug and driving problem. The study entitled The Incidence of Drugs Among Fatally Injured Drivers will estimate the prevalence of drug use in this crash population and will describe regional and other differences in terms of drugs and drug groups found. The project entitled A Study of Driver Behavioral Errors and Alcohol, Marijuana, and Other Drug-Involved Collisions focuses less on the percentage of drug-involved accidents than on driver behaviors and errors associated with drug-involved traffic crashes. A comprehensive approach that includes drug analysis, driver interviews, and accident investigation is being used in this study.

Future surveys of drug use among drivers may be sponsored by the National Institute on Drug Abuse. A letter soliciting applications for research grants in this area was released by the Psychosocial and

TABLE 4-5

SELECTED ONGOING AND PLANNED RESEARCH ON THE PREVALENCE OF DRUGS IN DRIVING POPULATIONS

TITLE (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Clinical Studies in Alcohol Use and Abuse (Psychiatry Service, U.S. Veterans Administration Medical Center, Palo Alto, California	U.S. Veterans Administration Department of Medicine and Surgery, Washington, DC (481-44-8279, 640-002-P)	248 incarcerated juvenile delinquents have been examined to investigate the relationship between drug and alcohol use and behavior problems, including "trouble driving." Further work continues with individuals convicted of assaultive crimes.
Relationship Between Drug Use and Violent Crime in Adolescent Offenders (Psychiatry Department of the Stanford University School of Medicine)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-76-3313)	By studying a delinquent juvenile population, the investigator attempts to identify which drugs are related to specific delinquent activities. With regard to their reported frequency of use among youth, the study identifies which drugs are overrepresented in assaultive crime and which are underrepresented. An attempt is also made to determine other effects attributed to drug use by delinquents such as memory dysfunction and driving accidents.
Longitudinal Study of Teenage and Young Adult Drug Use (Massachusetts General Hospital)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (R01 DA 00065-07)	This study investigates the antecedents and sequelae of drug use among teenage students and young adults by analyzing a comprehensive, 13-year longitudinal data base collected from 2,500 subjects. Responses to questions regarding alcohol and drug use, family life, and school gathered between 1969 and 1976 will be compared to responses to similar questions asked between 1979 and 1981. Topics covered include accidents and contacts with the criminal justice system.
Drug Use and Lifestyles of American Youth (University of Michigan Institute for Social Research)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (R01 DA 01411-04)	Questionnaires concerning drug, alcohol, and cigarette use, attitudes, values, lifestyles, future plans, employment, and family life will be given to 19,000 high school seniors and to 5,000 individuals who participated in the survey the previous three years. This is the fourth year of the study. Questions concerning drug use and driving are included.

TABLE 4-5

SELECTED ONGOING AND PLANNED RESEARCH ON THE PREVALENCE OF DRUGS IN DRIVING POPULATIONS (Continued)

TITLE (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Survey of Drug Related Casualties (Center for Human Toxicology, University of Utah School of Medicine)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-78-3532)	This study attempts to determine the frequency of the presence of cannabis in accidents by collecting radioimmunoassay or EMIT assay data from toxicologists and others who have access to human biological samples from accident victims. An attempt is made to correlate cannabinoid presence with sex, age, and time of accident.
The Incidence of Drugs Among Fatally Injured Drivers (The University of Michigan Highway Safety Research Institute)	National Highway Traffic Safety Administration, U.S. Department of Transportation (DOT-HS-8-02024)	A study of the prevalence of drugs including alcohol in a national sample of fatally injured drivers. Geographical, urban-rural, and other differences related to drug presence will be identified. If feasible, the prevalence of drugs among a group of living drivers involved in traffic crashes will be determined.
A Study of Driver Behavioral Errors in Alcohol, Marijuana, and Other Drug-Involved Collisions (Calspan Field Services, Calspan Corporation)	National Highway Traffic Safety Administration, U.S. Department of Transportation (DOT-HS-5-01179)	A study that combines the analysis of blood specimens from injured drivers for a wide range of drugs, interviews with drivers, and full-scale investigation. The purpose of this research is to determine different types of driving errors or driver problems associated with drug and no-drug traffic crashes.

Research Technology Branches of the Division of Research, NIDA. It is expected that NHTSA would cooperate in these efforts, for example, by supplying data from accident populations for comparison and by participating in the analysis of findings. At present, no surveys based on chemical analysis to determine the prevalence of drug usage in the population of drivers at risk could be identified in the United States. If funded, well-designed and coordinated research on the use of drugs in this driving population would represent a major step forward in defining the national drug and driving problem.

Other Efforts to Compile Data on Drug Use by Drivers

In addition to research outlined above, state and local efforts described by respondents as "special" were identified (Table 4-6). These ongoing programs to detect and measure drugs in the body fluids of drivers serve to indicate the magnitude of the drug and driving problem within each jurisdiction. Findings from these kinds of projects are often limited in value due to problems associated with obtaining specimens from all cases arising in a jurisdiction. Possible bias in the selection of cases, especially drivers arrested for driving under the influence, must be considered in assessing findings from these efforts. Similar programs have been planned for the near future in North Dakota (State Toxicology Laboratory), South Dakota (State Division of Drugs), and Wisconsin (State Laboratory of Hygiene).

Federal agencies that have an involvement in the area of drugs and driving include the National Transportation Safety Board (NTSB) and the Bureau of Motor Carrier Safety (BMCS), Federal Highway Administration, U.S. Department of Transportation. The Highway Accident Division of the Bureau of Accident Investigation, NTSB, investigates about ten highway accidents a year. According to officials in this agency, investigators include analysis for the presence of alcohol and other drugs, performed by the Armed Forces Institute of Pathology. While they believe it is important to show the presence of drugs as contributing factors to traffic crashes, the investigations emphasize other factors.

The BMCS investigates and determines probable causes and contributing

TABLE 4-6

SPECIAL ONGOING EFFORTS TO DETECT
AND MEASURE DRUGS IN BODY FLUIDS OF DRIVERS

AGENCY	POPULATION OF DRIVERS	FUNDING SOURCE *	DURATION OF STUDY
Department of Forensic Sciences, Auburn, Alabama	Driver fatalities	State	1 year
Department of Toxicology Indiana University Medical School, Indianapolis, Indiana	Driver fatalities and drivers arrested for driving under the influence of drugs (DUID)	State	1 year
State Forensic Laboratory Boise, Idaho	Driver Fatalities	State	1 year
Medical College of Ohio Toledo, Ohio	Trauma Victims, including injured drivers	State	2 years
Consolidated Laboratory Services, Richmond, Indiana	Drives arrested for impaired driving, low blood alcohol concentration (BAC)	State	2 years
Mississippi State Crime Laboratory Jackson, Mississippi	Driver fatalities and drivers arrested for driving while intoxicated, low BAC	Federal, DOT	3 years
Office of State Medical Examiner North Carolina	Driver fatalities in single vehicle crashes	State	1 year (extension applied for)
State Laboratory of Hygiene, Wisconsin	Traffic Fatalities	Federal (DOT 402)	3 years

* The sources of funding for the identified programs are listed as "state" or "federal" according to information received from each agency. Agencies at the state level often provide funding derived ultimately from federal sources, such as the U.S. Department of Transportation's 402 program.

factors in highway-related crashes (U.S. Department of Transportation 1977). Among human factors are included the use of alcohol and other drugs. In a four-year period, (1973-1976), drugs other than alcohol were considered factors in 11 out of 460 accidents. An official in the Regulations Division, BMCS said that in-depth accident investigations identify drug-involvement only if an autopsy is performed or if physical evidence of drug use is found.

SUMMARY

In summary, epidemiologic research in the United States has established that drivers who use drugs are involved in traffic crashes and that many persons arrested for driving under the influence have drugs in their body, often in amounts that can reasonably be expected to impair driving ability. Studies done to date are indicative of a problem but not definitive. Studies comparing crash-involved drivers with noncrash-involved drivers have not been conducted. Until such studies are funded and carried out, the state of knowledge about drugs and driving will not advance.

Efforts to analyze body fluid specimens for drugs by agencies involved in law enforcement or death investigation represent another source of data on the drug and driving problem. Information thus obtained is at times reported in the literature, but more often is not compiled for publication.

From the point of view of defining a drug and driving problem, past studies of the prevalence of drugs in drivers' body fluids evidence many deficiencies. This judgment, derived from numerous research reviews, is not intended to condemn past efforts. Most of the studies referred to were not intended to define the problem, but merely to indicate the possibility of its existence. Nevertheless, if a drug and driving problem is to be defined, systematic, scientific studies that address such issues as listed in Table 4-4 must be conducted.

The implications of past research are obvious. In particular, representative samples of crash-involved drivers must be compared to suitable control samples from the general driving population. Adequate

methods to analyze blood specimens for a broad range of drugs of interest, along with approaches that encourage cooperation by at-risk drivers, should be developed for use in these surveys. Until such research is carried out, the drug and driving problem will remain an undefined--yet volatile—issue.

CHAPTER FIVE

DETECTION AND QUANTITATION OF DRUGS IN BODY FLUIDS

In highway safety research, the analysis for drugs in body fluids supports epidemiologic and experimental studies to define the drug and driving problem. Local efforts to deal with drug-impaired driving have also depended on methods to detect and measure inappropriate drug use by drivers. In the past, the absence of sensitive methods for some drugs (e.g., marijuana, benzodiazepines)--or the unavailability of methods in toxicology laboratories--have hampered both research and enforcement efforts. Because research and development of analytical methods is so important to advancing the state of knowledge of drugs and driving, this section describes:

- common analytical techniques used to detect and to quantitate drugs in body fluids; and
- current applications of techniques and methods to analyze the body fluids of drivers for drugs.

Most topics concerning the detection and measurement of drugs apply both to marijuana and other drugs. Therefore, unlike previous sections, no special subdivision between marijuana and other drugs is made in this section.

Information on these topics was obtained from two major sources:

- articles and reports dealing with analytical methodology and the current state of the art; and
- contacts with medical examiners, coroners, toxicologists, and researchers who are developing and applying analytical techniques used to detect and measure drugs in body fluids of drivers.

A final section summarizes the current state of the art in analytical methodology, comparing with it current practices in the United States.

BACKGROUND

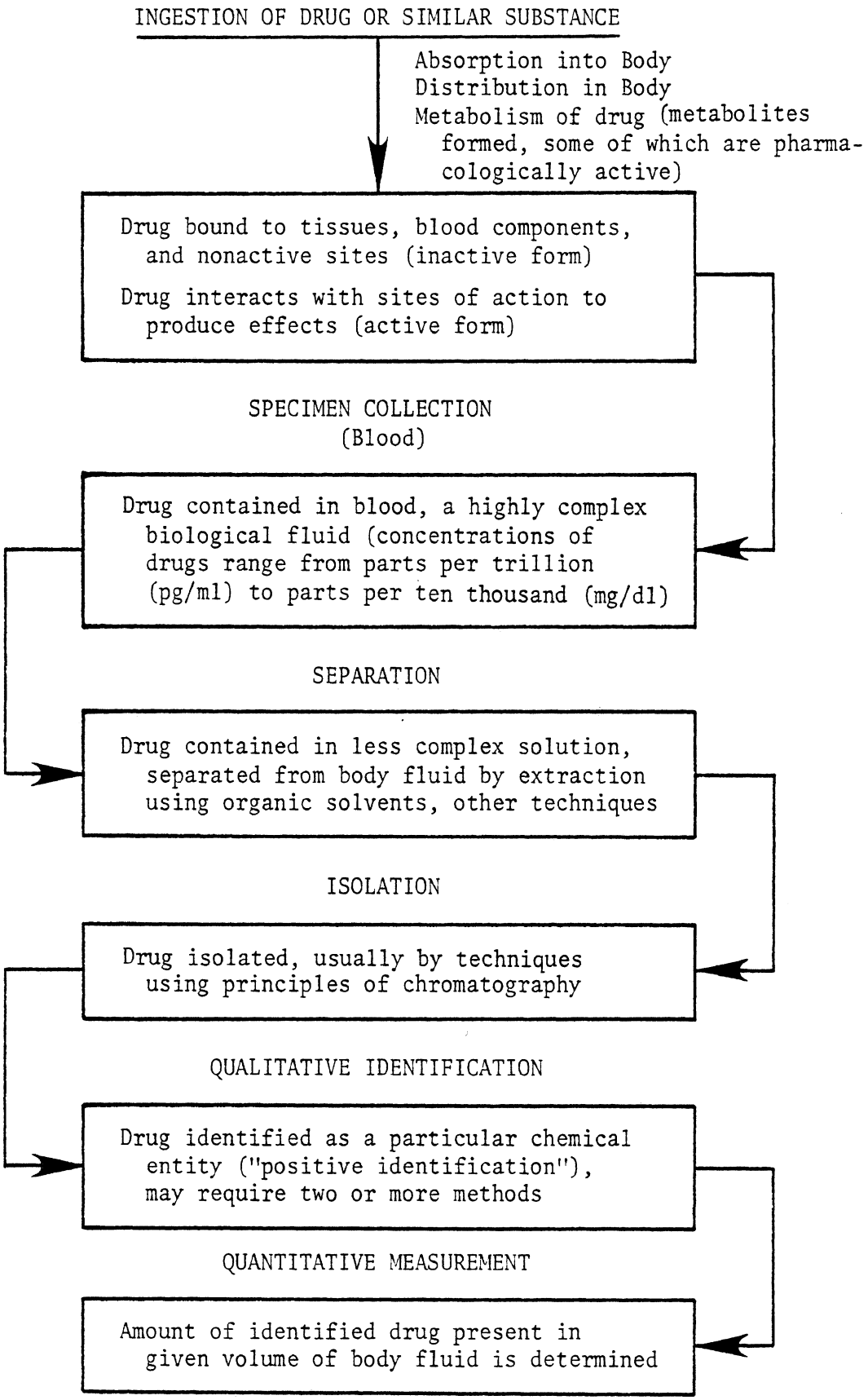
The detection and measurement of drugs in body fluids is a process that starts with collecting a specimen and ends with determining the amount of drug present. Figure 5-1 illustrates this process and identifies general steps taken to complete it. Each step is important, though with some modern techniques, a chemist can avoid certain intermediate steps. The process of analyzing for drugs in body fluids has been described in detail elsewhere in the scientific and highway safety literature (e.g., Sunshine 1975; Joscelyn and Maickel 1977a; Joscelyn et al. 1979), and is briefly summarized here in the context of highway safety. General statements intended to simplify the description of drug analysis are made, for which specific exceptions can always be found. The purpose of the discussion is not to present a highly technical discourse on drug analysis, but rather to provide to the reader enough basic information so that understanding of the remaining material may be facilitated.

A drug or similar substance can be ingested in several ways; orally, by inhalation, or by injection are the most common routes of administration. As a drug is taken into the body, it is absorbed and distributed by the circulation of blood. Both active (free) and inactive (bound) forms of drug are present. Interaction of drugs with enzymes in the body (especially in the liver) produces drug-like chemicals known as metabolites. Some of these act like the parent drug and can have effects on behavior.

A specimen of blood must be obtained from a driver—living, fatally injured, injured, or arrested for impaired driving--in order to detect and to measure the drug or drugs. At present, **blood is the only specimen from which meaningful analytic results can be obtained** (Joscelyn et al. 1979, pp. 292-93). Blood, especially whole blood in which red cells have broken down (hemolyzed blood), is an extremely complex fluid. Most drugs are present in concentrations ranging from parts per trillion to parts per ten thousand. The complexity of blood and the presence of drugs in minute amounts require sophisticated chemical tests for its analysis.

FIGURE 5-1

THE ANALYSIS FOR DRUGS IN BLOOD



Most methods of drug analysis involve four distinct steps:

- **separation** of drug and other substances from blood;
- **isolation** of the drug from other chemicals present in the less complex organic solution;
- **qualitative identification** to establish the presence of a given drug; and
- **quantitative measurement** of the amount of identified drug present in the unit volume of blood.

A separation step is required to extract a drug from blood so that the resulting solution can be more simply analyzed. With the exception of certain techniques, detectors of chemicals are not specific enough to identify the presence of a single drug accompanied by a host of interfering substances. Separation techniques include:

- liquid-liquid extraction,
- molecular sieves (gels, resins),
- ion exchange,
- distillation, and
- chromatography (column, paper, thin-layer, and gas).

Of these, the first two listed are most often used. Chromatography is used more in isolation procedures following initial "clean-up" (Sunshine 1975, p. 392).

Even after separation, an **isolation step** is often necessary to gather together one drug by itself for identification. Chromatographic techniques widely used for this purpose include those mentioned above as well as gel permeation and high-pressure liquid chromatography (HPLC). Because drugs differ in their physical and chemical properties, no one isolation technique will recover all drugs for further analysis. Screening systems comprising several such techniques increase the generality of drug analysis. Use of several isolation procedures for a single specimen is often an advantage, since separate methods are used to identify different drugs and classes of drugs.

Chemical or electronic detection of the drug follows its isolation from solution. In most analytical procedures, detection and identification of

drugs depend wholly on isolation techniques. For example, in gas chromatography, "on-line" detectors measure the presence of drugs separated and moved along a column by a flow of gas. The time a drug takes to move through the column is relatively constant, enabling its identification. Detectors vary in their complexity, analytical characteristics, and cost. Detectors for gas chromatography, for instance, range from simple flame ionization to mass spectrometers, which differ in cost and ability to identify drugs by many orders of magnitude.

Quantitative measurement of the amount of drug originally present in a blood specimen depends on several factors:

- the amount of blood extracted;
- the percentage of drug removed from the blood by extraction (separation);
- the percentage of drug obtained for analysis (isolation); and
- the amount of drug introduced into an instrument for quantitation, once it has been identified.

To simplify calculation of these factors, known quantities of other chemicals are added to blood specimens before the separation step. These chemicals, called internal standards, behave similarly throughout the analysis and the amounts of internal standards determined at the last step provide an estimate of the concentration of a drug originally in blood.

An important consideration is that, in almost all cases, the analyst does not know which—if any--drug(s) are present in a body fluid specimen. Systematic analyses, called drug screens, are required. The analyst can only find those drugs his instruments can detect and identify, at concentrations within the limits of sensitivity of his methods. Because drugs number in the thousands, he will analyze specimens for those drugs of interest whose presence can reasonably be expected. Other drugs will go unnoticed. Costs of extensive drug screening and requirements for special methods to detect certain drugs or groups of drugs limit the range of drugs for which analyses are performed.

Table 5-1 lists and defines characteristics of analytical methods.

TABLE 5-1

CHARACTERISTICS OF A METHOD TO DETECT AND MEASURE DRUGS IN BODY FLUIDS

CHARACTERISTICS	DEFINITION
Specificity	The capability of a method or technique to distinguish between individual drugs or classes of drugs.
Sensitivity	The ability of a method to detect the presence of drugs or classes of drugs.
Speed	The time from start to end of the analytical process using a method.
Simplicity	Usually related to the speed of a method, the requirement for little training for technicians and often associated with highly automated procedures.
Reliability	The dependability of a method. Its ability to reproduce accurate and precise results day to day.
Accuracy	The degree to which a method produces results consistent with actual values.
Precision	The consistency with which a method reproduces results when measuring the same sample.
Economy/Cost	Economic considerations include time of analysis, number of samples processed in a single run, degree of training required of personnel, price of obtaining (and maintaining) instrumentation, price of chemicals and other reagents used in analytical procedure, and overhead of analytical laboratory or other facility.
Safety	The degree to which personnel using a procedure are exposed to risk of injury or long-term toxicity associated with chemicals required by a method.

Those terms are often used in comparing different instruments, techniques, and methods for drug analysis. For almost all drugs, more than one kind of method can be applied to its analysis in body fluids. Which method is "best" depends on what information is required of an analysis. As Joscelyn et al. (1979) pointed out, requirements for drug analyses in highway safety research are very stringent, demanding that drugs **not present** be identified along with drugs present in a specimen. For example, epidemiologic research determines the percentage of drivers in a population who use certain drugs; this information can only be obtained if **both** the number of drivers using drugs **and** the number of drivers **not** using drugs are determined. Drug countermeasures based on analyses of body fluids have equally strict requirements, since methods used to provide evidence in legal proceedings must meet forensic standards.

General techniques used in analyzing body fluids for drugs include the following:

- thin-layer chromatography (TLC),
- gas chromatography (GC),
- gas chromatography-mass spectrometry (GC-MS)
- immunoassay, and
- high pressure liquid chromatography (HPLC).

Certain techniques may be more appropriate for some drugs than others; methods based on the same technique differ, even for the same drug, depending on purposes for which each method was developed. For some drugs there may be a "method of choice," but usually the selection of a particular method depends on the availability of required instrumentation, funding, and the preference of analysts themselves (Sunshine 1975; Maickel 1977; Marks and Fry 1977).

Thin-layer chromatography (TLC), one of the oldest techniques in common use, is rapid, inexpensive, highly specific, sensitive enough for most drugs, and easily adapted to many analytical needs. Most TLC procedures are simple, requiring a minimum of expertise. Its characteristics are applied to best advantage in the preliminary identification of drugs; it is less suitable for measuring the amount of drug in a specimen. Additional techniques are required to confirm and to

quantitate results of TLC analysis (Maickel 1977; Marks and Fry 1977; Joscelyn et al. 1979).

Gas chromatography (GC) combines isolation, qualitative identification, and (in some procedures) quantitative measurement. In many laboratories that can afford the initial costs of purchasing the necessary instruments, this technique has largely displaced TLC. The advantages of GC include the variety of available detectors, both "universal" and selective, most of which are highly sensitive. Like TLC, GC methods can detect a wide range of drugs. Unlike TLC, however, only one sample can be analyzed at a time, but quantitative results can be obtained directly. Confirmation of findings for positive identification and accurate quantitation is still required (Maickel 1977; Joscelyn et al. 1979).

Gas chromatography-mass spectrometry (GC-MS) techniques with computer-operated systems have been increasingly applied to drug analysis in research and forensic laboratory settings (Klein, Kruegel, and Sobol 1979). The marriage of GC with mass spectrometry (MS), a technique that records a drug's "fingerprint," combines efficient separation of drugs with positive identification of each drug present. The power and versatility of this technique are great, but its availability is not. The cost of purchasing, maintaining, and operating GC-MS equipment is beyond the reach of most toxicology laboratories (Maickel 1977).

Immunoassay techniques are relatively new to the area of drug analysis (Butler 1977). Immunoassays are extremely sensitive, highly selective, and rapid procedures; large numbers of samples can be processed simultaneously. There are specific drawbacks to some immunoassay techniques, e.g., reagent costs, the need for skilled technicians, and facilities for handling radioactive materials (radioimmunoassay [RIA]). On the other hand, separation and isolation steps in the analytical process are avoided, and these techniques serve well when a low percentage of positive findings is expected (Sunshine 1979).

High-pressure liquid chromatography (HPLC) is another technique recently and rapidly developed for drug analyses and other applications (Wheals and Williams 1979). Operating at or near room temperature,

HPLC instruments can isolate and detect thermally unstable and nonvolatile compounds; these characteristics are complementary to gas chromatography (Parris 1976). Limited primarily by detector systems, HPLC techniques have found special applications but will probably remain in a secondary role in drug analysis, both screening and quantitative measurement, for some time to come (Jane 1975; Bye and Brown 1977).

Once the presence of one or more drugs has been determined and their concentrations measured, the analytic findings must be **interpreted.** This final and crucial step follows the analysis of body fluids for drugs and depends on the accuracy and precision of the methods used. But interpretation of blood drug concentrations (BDCs) also depends on prior knowledge of what the analytic results mean in terms of driver impairment.

Significant precedents were set when blood alcohol concentration (BAC) as determined by chemical tests was made legally admissable as evidence of driver impairment. Some states even have "per se" laws, making it illegal to drive with a BAC exceeding a statutory limit, e.g., 0.10% w/v. Extensive research correlating the behavioral effects of alcohol and BAC supported this approach.

Similar research for other drugs is rarely done. Considerable work in the separate areas of pharmacokinetics and behavioral effects has been reported, but very few efforts to define the relationship between impairment of driving-related skills and BDCs for any drug other than alcohol have been made (Joscelyn et al. 1979). Because this kind of research is complex and difficult, it may not be feasible to develop BAC-equivalents for other drugs in the near-term future. As a consequence, the ability to interpret analytic findings in traffic-related cases is far exceeded by the ability to detect and measure drugs in body fluids. Cases in which multiple drugs are detected and measured, an increasingly frequent occurrence, often present even greater problems for interpretation.

This issue--interpretation of analytical results--is basic to any discussion of drug analysis in highway safety research and action programs. The following sections address current practices by operational

agencies and the state of the art related to drug analysis, but present limitations in the use of analytic findings should be kept in mind.

CURRENT PRACTICES REPORTED BY AGENCIES ACTIVE IN ANALYZING DRIVER BODY FLUIDS FOR DRUGS

The analysis for drugs in body fluids has been cited as a basic deficiency not only in past research but also in enforcement programs (California Highway Patrol 1974; Silverstone 1974; Kapur 1975; Joscelyn and Maickel 1977a; Willette 1977; Joscelyn et al. 1979). Of primary concern are methods to detect and measure drugs in blood, the body fluid of choice for analyses meaningful in the context of highway safety. Methods to detect marijuana use by drivers are still under development and few if any laboratories apply them in routine practice. The literature of analytical chemistry indicates that satisfactory techniques and methods have been developed for almost all other drugs (Sunshine 1975). Their application in research or in laboratories serving police or other agencies is less certain. Information on current practices is important because findings reported by these agencies depend on the number and kind of drugs tested for.

The following study serves to illustrate the obvious truth that only those drugs tested for will be found, and that the absence of reported findings for drugs not tested does not mean that these drugs were not also present. Lundberg, White, and Hoffman (1979) reported a collaborative effort by thirteen California laboratories between May 1973 and December 1975. The number of drugs included in analyses ranged from 1 to 48 (mean of 21). Drugs most frequently assayed included barbiturates (99.8%); ethyl alcohol (99.3%); the sedative-hypnotics glutethimide (90%), meprobamate (89%), and ethinamate (87%); diazepam, methaqualone, and chlordiazepoxide (82%). Drugs most frequently **not** tested for included marijuana (100%); phenothiazine (major) tranquilizers, morphine, chloral hydrate, and cocaine (95%); methadone, meperidine (pethidine), and methamphetamine (94%); and codeine, amphetamine, and amitriptyline (93%). In descending order, barbiturates, ethyl alcohol, diazepam, methaqualone, chlordiazepoxide, meprobamate, and ethchlorvynol

were most frequently found. (It is important to note that 512 of the 765 cases involved two or more drugs; 292 of the 512 polydrug cases involved alcohol.) The greater frequency of barbiturates in this study probably resulted from the type of specimen analyzed. Breath tests for alcohol are usually administered to persons arrested for impaired driving.

To obtain information on current practices, referrals to analytical laboratories were solicited from Governors' Highway Safety Representatives and other state government contacts. Additional referrals were obtained during the data collection effort. Constraints inherent in this study (limited staff, time, funding) prevented the contacting of all laboratories that perform analyses for drugs in drivers. Several states are not represented by the group of agencies contacted; in addition, every agency contacted did not--or could not--provide all the information desired. Thus, while responding laboratories do represent the kind of agencies active in this area, findings presented below are only indicative of current practices. More comprehensive and inclusive studies are required to confirm this information.

Seventy-one agencies across the United States were contacted by telephone. Of these contacts, forty-nine were in some way involved in drugs and driving, including:

- offices of medical examiners and coroners;
- state health and toxicology laboratories, local laboratories including police facilities;
- private laboratories; and
- other analytical laboratories, including some associated with educational institutions.

Each agency contacted was asked to provide information describing past, ongoing, and planned activity related to drugs and driving, including:

- type of activity (special, routine);
- source of funding (federal, state, local);
- type of driver (deceased, injured, arrested);

- case load;
- percentage of drivers in jurisdiction tested for drugs;
- analytical techniques used to analyze body fluids for drugs;
- past and present results of drug analyses and the use of such findings;
- problems and constraints faced by laboratories that perform drug analyses; and
- perceptions about the drug and driving problem and about future activity needed in this area of highway safety.

Agencies unable to provide this information either had no responsibility for analyzing specimens obtained from drivers or analyzed specimens for alcohol only. Many agencies gave incomplete responses or information that lacked detail. Because many laboratories do not compile statistics or perform only those analyses requested by other agencies, some responses represented the opinion of the laboratory representative. The limitations of this study's findings, however, reflect the approach required for collecting data. This study was not a survey; information was obtained informally by telephone. No attempt was made to press those contacted for detailed, standardized descriptions of their activity. Nevertheless, many agencies did provide extensive information. Their cooperation has allowed the following--albeit limited--report on current practices related to drugs and driving.

Extent and Nature of Activity

Of seventy-one agencies contacted, forty-nine indicated past, present, or planned activity related to drugs and driving. For almost all, these efforts were considered routine, that is, part of the ongoing operation of these agencies. Because these were state and local agencies, the primary sources of funding were also state and local. Special efforts within the scope of activity of seven agencies were identified; these are described in Chapter 4. Although state support was indicated, federal highway safety dollars appeared to be a source of funding for several of these efforts.

Most of the activity involved the analysis for drugs in blood specimens from fatally injured drivers. Some laboratories analyzed for drugs in both deceased and arrested drivers. Fewer than twenty of the seventy-one laboratories contacted routinely analyzed for drugs other than alcohol in impaired driving cases. Numbers of cases per month involving traffic fatalities ranged from one to fifty. Relatively few medical examiners or toxicologists reported that analyses for drugs were performed in all cases of fatally injured drivers in their jurisdiction. Analyses for arrested drivers were typically in the range of ten to thirty-five cases per month. The Forensic Sciences Services of the Orange County Sheriff-Coroner's Department, California, reported analyzing about one hundred and fifty specimens a month from drivers arrested for driving under the influence. Those agencies that do perform drug analyses in impaired driving cases typically restrict analyses to specimens containing less than the legal limit for blood alcohol concentration or perform specific analyses at the request of police agencies. This activity represents a very low percentage of all such cases arising in a jurisdiction.

Analytical Techniques Used to Detect and Measure Drugs in Body Fluids of Drivers

Of the seventy-one agencies contacted, nineteen offices of medical examiners and twenty-one toxicologists from other agencies provided information on analytical techniques used to detect and measure drugs in body fluids of drivers. Although detailed information was obtained from many of those contacted, responses varied in ways that made comparisons difficult. For example, different classifications of drugs were used; some toxicologists referred to acidic, basic, neutral, and volatile drugs when describing their analytical procedures. These chemical classes are inclusive of better known therapeutic classes such as barbiturates, stimulants, antianxiety agents, and alcohol respectively. Other toxicologists used these latter, more specific drug classes when naming techniques for drug analysis. Nevertheless, some general observations based on these findings are possible.

1. In screening body fluids for drugs, most laboratories employ several techniques. In general, older, less expensive approaches to drug screening were favored.

2. The screening technique most often mentioned was thin-layer chromatography, followed by gas chromatography, ultraviolet spectrophotometry, and immunoassay.

3. To confirm positive findings, gas chromotography and gas chromatography-mass spectrometry were used more often than all other techniques combined. While other techniques can measure the amount of drug present in a specimen, gas chromatographic techniques are particularly useful in obtaining quantitative results.

4. In general, the concentrations of drugs in body fluids detectable by screening techniques were higher than those measured by confirmatory techniques. Although the latter techniques are usually more sensitive, drugs present in concentrations below the detection limit are not found during screening and therefore are not confirmed.

5. Controlled substances represented the majority of drugs or drug classes for which screening was done. In descending order, barbiturates, stimulants, tranquilizers, and opiates were most often mentioned.

6. Confirmatory or quantitative analyses also emphasized controlled substances.

7. Conspicuous by their absence, marijuana and hallucinogens were rarely mentioned, indicating the limited availability of techniques or methods for their analysis in body fluids, especially blood.

The results of analyses are used according to the operational role of each agency. Offices of medical examiners include positive findings in their reports of death investigation. Toxicologists with other agencies said that analytical results were sometimes used as evidence in adjudicating driving-under-the-influence cases. Most significantly, only twenty-two of forty-nine agencies compiled statistics that indicate the frequency with which drugs are detected in fatally injured or impaired drivers.

ISSUES RELATED TO DRUG ANALYSIS AND HIGHWAY SAFETY

As discussed in Chapter 4, past epidemiologic research in drugs and highway safety has been limited by the lack of methods to detect certain drugs of interest, most notably marijuana. In addition, when specimens of body fluids from drivers have been analyzed, methods "have lacked the required sensitivity or have not detected the active form of the drug or have been limited to a restricted set of drugs. Moreover, no comparisons among studies are possible, since different methods were chosen. Since only a few studies have been performed, the results available are fragmentary" (Joscelyn et al. 1979, p. 55).

In recent years, with the technical advances in drug analysis, methods to detect drugs at concentrations consistent with normal usage patterns have been developed. In reviewing analytical methodology, Gorodetzky (1977) concluded the following:

> In the last 5 years much progress has been made in the development of both screening and quantitative analytical methods for drugs of abuse in biological fluids; and a wide range of capabilities is now available. Continued methodologic development is likely, with increases in sensitivity and specificity, decreasing cost, and greater automation and simplicity of performance. A broader range of more specific, sensitive, and quantitative immunoassays are likely to be available. (p. 395.)

Drugs for which analyses have been difficult--if not impossible--can now be detected and measured in blood with modern techniques such as radioimmunoassay (RIA) (Castro and Malkus 1977) and gas chromatography with nitrogen phosphorous detector (Pierce et al. 1978). Reports describing methods for marijuana (Rosenthal et al. 1978; McCallum et al. 1978; Vinson 1979), LSD (Twitchett et al. 1978), and benzodiazepines (Missen 1977; Peat and Kopjak 1979) appear with increasing frequency in the literature.

If the availability of adequate techniques and methods is no longer a primary issue, the availability of laboratories equipped with them may yet be. As indicated above, very few laboratories report using methods to detect the use of marijuana. But other than analytical constraints exist.

Nineteen agencies and laboratories not analyzing for drugs in specimens from drivers indicated that their **present workload** and **limited funds** prevented activity not directly related to their main role. Only four laboratories mentioned limited analytical methods as a reason for not performing drug analyses. All laboratories stated that, if needed resources were obtained, analyses for drugs in driving populations could and would be done routinely. One issue raised by some toxicologists cannot be solved by additional personnel or economic support--the difficulty in obtaining specimens. Reasons for this difficulty included:

- police do not obtain blood specimens for analysis;
- present laws do not permit the drawing of blood for analyses; and
- police do not perceive the need for analyses other than for alcohol and, therefore, do not request analyses for other drugs.

Even laboratories reporting the analysis of specimens from deceased drivers raised similar issues. The lack of funds to conduct public health research in addition to duties required by law was most often mentioned as a reason for not analyzing a higher percentage of specimens for drugs.

Although many laboratories currently analyze the body fluids of drivers for the presence and amount of drugs, data obtained in routine practice do not satisfy informational needs in highway safety. For example, many drugs of interest are excluded in the analyses performed. Only those drugs tested for are found. In addition, since many toxicologic laboratories routinely screen for toxic concentrations of chemical agents, drugs at therapeutic concentrations that can impair driving may often be missed.

Research on drugs and driving places demands on forensic laboratories over and above analytic requirements faced in daily practice. To enhance the quality--and quantity--of data on traffic cases handled by these agencies, additional support from federal and state agencies concerned with highway safety is needed. To supplement information from formal research projects, the coordination of laboratories across the country

should be considered, with careful attention to the comparability of data among participating agencies.

RESEARCH AND DEVELOPMENT IN ANALYTICAL METHODOLOGY

Despite remarkable advances in technology, all of the analytical problems faced in highway safety have not been solved. For example, a reliable, widely available method for detecting and measuring marijuana use in blood has yet to emerge. Also desired is portable instrumentation that could be used at roadside by enforcement officers for testing drivers believed to be driving while impaired by drugs. Another constraint both in research and in enforcement is the necessity to obtain blood specimens; alternative body fluids more easily obtained, for example, saliva, might be suitable for the analysis of some drugs. Research and development in analytical methodology are ongoing, sponsored in particular by two federal agencies, the National Highway Traffic Safety Administration (NHTSA) and the National Institute on Drug Abuse (NIDA).

NHTSA currently supports one effort to advance the state of the art of analytical methodology for drugs other than alcohol:

- Contract No. DOT-HS-7-01737: Analysis for Drugs in Saliva and Breath (Research Triangle Institute, Durham, NC)

  This project includes the development of methods for drug analysis that would be useful in future epidemiologic research. Methods would analyze breath or saliva or both for detection and quantitation of selected drugs that are considered possible highway safety hazards.

The National Institute on Drug Abuse more extensively supports the development of analytical techniques and methods for marijuana analysis in body fluids (Table 5-2). Numerous other related efforts are currently funded by NIDA as part of the agency's Marijuana Program. Recent reports in the literature indicate similar areas of funding by other federal agencies (Vinson 1979); activity in private industry (Chase et al. 1976); and independent efforts by faculty in universities (Vinson, Patel, and Patel 1977).

In addition to the development of analytical techniques and the field

TABLE 5-2

SELECTED ONGOING AND PLANNED RESEARCH ON THE ANALYSIS OF MARIJUANA AND OTHER DRUGS IN BIOLOGICAL FLUIDS

TITLE (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Development and Validation of New Marihuana Technology (Missouri University, Kansas City, School of Medicine)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (DOT-HS-7-01527)	This project involves the development and validation of practical methods for measuring the amount of marijuana constituent(s) in the body. Correlation of concentrations in saliva and blood is planned. Methods to detect marijuana use and concentrations in breath are to be developed. Also to be developed are time-concentration curves for various marijuana metabolites in blood, breath, and saliva that permit recalculation for up to four hours before sample collection.
Analysis for Drugs in Saliva and Breath (Research Triangle Institute, Durham, NC)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (DOT-HS-7-01737)	This project includes the development of methods for drug analysis that would be useful in future epidemiologic research. Methods would analyze breath or saliva or both for detection and quantitation of selected drugs that are considered possible highway safety hazards.
Dosage Forms and Analysis for Marijuana Compounds (Research Triangle Institute, Durham, NC)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-78-3528)	An extensive, multi-faceted project that involves, among other tasks, development of highly sensitive, specific techniques for analyses of marijuana constituents and the completion of development and initiation of field testing for routine radioimmunoassay (RIA) procedures for the analysis of biological materials containing cannabinoids.

TABLE 5-2

SELECTED ONGOING AND PLANNED RESEARCH ON THE ANALYSIS OF MARIJUANA AND OTHER DRUGS IN BIOLOGICAL FLUIDS (Continued)

TITLE (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Production of EMIT Kits for Cannabinoids (Syva Corporation, Palo Alto, California)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-78-3518)	This contract provides for the production of assay kits which can provide a one minute analysis of urine to indicate the presence or absence of marijuana metabolites. These kits are presently undergoing field testing.
Evaluation of Immunoassay Kits for Estimation of Drug Related Casualties (University of Utah, Salt Lake City, Utah)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-78-3532)	Immunoassay kits for the analysis of marijuana constituents in biological fluids are being field tested to assess their reliability, accuracy, etc. One of these is the EMIT kit mentioned above, the other two are radioimmunoassay kits.
Cannabinoid Quantification Service Laboratory (Research Triangle Institute, Durham, NC)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-79-3621)	This contract provides for the production of radioimmunoassay (RIA) kits for the analysis of delta-9-tetrahydrocannabinol in plasma. These kits are being distributed on a selective basis to investigators who are in a position to both evaluate the usefulness of the kit and to use it to provide research data. A second phase of this contract is to provide a service laboratory function for the RIA analysis of plasma samples sent to the facility from NIDA-selected research investigators.

TABLE 5-2

SELECTED ONGOING AND PLANNED RESEARCH ON THE ANALYSIS OF MARIJUANA AND OTHER DRUGS IN BIOLOGICAL FLUIDS (Continued)

TITLE (PERFORMING ORGANIZATION)	SPONSOR (CONTRACT, GRANT NUMBER)	DESCRIPTION
Quantification of Cannabinoids in Biological Fluids (Research Triangle Institute, Durham, NC)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-80-3721)	This contract provides for the analysis of biological fluid samples for three specific marijuana constituents. Samples are provided to the facility by selected investigators from the drug abuse research community.
Service Laboratory for the Quantification of Drugs (University of Utah, Salt Lake City, Utah)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (271-80-3719)	This contract provides the analytical chemistry support for a contract with Southern California Research Institute (discussed in epidemiology section below). This involves the refinement and often the modification of existing analytical methodologies for determining the plasma concentrations of a variety of drugs of potential traffic safety concern including diazepam, secobarbital, chlordiazepoxide, diphenhydramine, and methaqualone.
New Immune Assays for THC and Drug Metabolites (Receptor Research Institute, Los Angeles, California)	National Institute on Drug Abuse, U.S. Department of Health, Education, and Welfare (DA-02076)	This grant is involved with basic research work which will lead to an immunoassay for marijuana constituents and other drugs. This method is based on principles similar to radioimmunoassays but is simpler and faster to use. It holds promise as a rapid, specific and sensitive method for a variety of drugs.

testing of methods to establish their reliability, other efforts related to drug analyses deserve mention. The ability of different laboratories to apply analytical methods in the analysis of body fluids may be the limiting factor both in highway safety research and countermeasure efforts (Joscelyn et al. 1979, p. 354). Two fundamental issues are:

- the selection and evaluation of laboratories to perform drug analyses of specimens from drivers obtained through research projects; and
- the comparability of analytical results produced by numerous laboratories associated with operational agencies, for example, offices of medical examiners and coroners and police departments.

Both the evaluation of methods **proposed** for detecting and measuring drugs in body fluids **and** the proficiency testing of laboratories engaged in drug analysis are important requirements in highway safety.

Ongoing programs to improve intralaboratory quality control and laboratory proficiency are conducted at the state and national levels (Buhl, Kowalski, and Vanderlinde 1978; Guerrant and Hall 1977). The need for quantitative analyses in highway safety--where mere presence of a drug does not mean a driver was under its influence--increases the importance of proficiency testing programs for laboratories that analyze the body fluids of drivers for drugs. Walberg (1977) outlined the purpose, organization, and conducting of such programs, and describes programs available to toxicology laboratories. Evidence for improved laboratory performance has been found, although analyses for some drugs still present problems for many laboratories (Guerrant and Hall 1977).

SUMMARY

The state of the art in analytical methods to detect and measure drugs in body fluids has advanced greatly over the past five years. General availability of modern techniques and methods to laboratories in operational agencies has lagged behind these developments, primarily due to personnel and funding requirements for their purchase, operation, and maintenance. Highly sensitive, specific--but lower cost--techniques for

rapid screening of body fluids (for example, immunoassays) promise to increase laboratory capabilities in the near future.

To complement a search and review of literature on analytical methodology, seventy-one agencies were contacted to obtain information on activity related to drugs and driving. Forty-nine of these reported some activity, mainly detection and measurement of drugs in deceased or arrested drivers. Information obtained by this effort suggested that current analytical practices in the United States tend to reflect the operational role of each type of agency. Toxicology laboratories apply more traditional techniques that allow efficient screening of body fluids for concentrations of drugs associated with intoxication or lethality. Therapeutic levels of some drugs would not be routinely detected in the course of normal operations. Nevertheless, the capability and interest to engage in drug and driving research (following the public health model of epidemiology) was expressed by all laboratories contacted. Additional funding would be necessary to enhance the quality and comprehensiveness of data on the prevalence of drug use among drivers.

Progress in developing methods to detect marijuana use among drivers has been substantial. Laboratories now analyzing for cannabinoids, the constituents of marijuana, are extremely few in number. Laboratories engaged in analysis for drugs may provide a rich source of data if the comparability of results can be enhanced by interlaboratory coordination and cooperation. Quality control and proficiency testing programs have an important role in this endeavor.

CHAPTER SIX

LAWS RELEVANT TO DRUGS AND HIGHWAY SAFETY

The next two chapters address countermeasures designed to reduce the incidence of drug-impaired driving and attendant crash losses. These countermeasures employ our nation's most common formal mechanism for controlling undesirable behavior, the legal system, and are called **legal** countermeasures. A background section in Chapter Six lays out the structure and general nature of laws related to drugs and highway safety. The remainder of Chapter Six describes in more detail two subclasses of laws related to drugs and driving: those aimed at controlling the use and abuse of drugs and those for controlling the drug-impaired driver. Chapter Seven discusses the **application** of laws controlling drug-impaired driving. The following discussion is based on information found in the literature, including applicable statutes, regulations, and court rulings, and on a series of contacts made with persons who manage and operate legal system agencies in the United States. These include contacts in federal, state, and local government.

BACKGROUND

Legal countermeasures use the resources and methods of the legal system to control traffic crash risk caused by drug-impaired drivers. Control is accomplished through four major mechanisms:

- **Law generation**—providing a set of laws and regulations;
- **Enforcement**--using police to reduce the frequency of law violations, either through mere presence of an enforcement threat or by detecting and apprehending violators;
- **Adjudication**--determining the guilt or innocence of a person charged with a law violation; and
- **Sanctioning**—imposing punishment or other legal sanctions on a person found guilty of a law violation (Jones and

Joscelyn 1976).

The legal system operates in two primary modes in performing these activities, a drug-control mode and a driver-control mode. The laws produced by the law generation mechanism are discussed in this chapter. The other three mechanisms--enforcement, adjudication, and sanctioning--are applications of those laws and are discussed in Chapter Seven.

Drug-control countermeasures are based on both federal and state statutes. Controls on drug manufacture and interstate distribution have their origin in federal statutes, while retail distribution is controlled by state statutes that are modeled after the federal statutes. Dowling (1971) notes that the original impetus for the federal drug control laws was the desire to remove inferior, unsafe, and ineffective products from the marketplace and to reduce the abuse of drugs. Not long thereafter, additional federal legislation was passed to deal with another drug-related problem, namely the abuse of narcotic drugs. Legislation dealing with both problems—poor quality drugs in the marketplace and the trafficking and use of drugs that can be abused—has grown since then in complexity and coverage.

The availability and use of drugs is now controlled by two separate but somewhat overlapping sets of legislation. The first of these consists of "pure food and drug" laws that are administered by the Food and Drug Administration (FDA) and are mainly quality-control measures concerned with protecting the public from inferior or dangerous products. The second set of laws, administered by the Department of Justice, consists of "narcotics control" laws intended primarily to restrict the supply and regulate the use of drugs that can be abused.

The federal statutes control both prescription and over-the-counter drugs. These controls govern the advertising, promotion, manufacture, and distribution of these drugs, as well as research and development. Narcotics and other substances of abuse are controlled at the federal level by Title II of the Comprehensive Drug Abuse Prevention and Control Act of 1970, often referred to as the Controlled Substance Act of 1970 or

CSA. This act classifies drugs according to the danger of their abuse. State statutes also classify drugs this way.

The effectiveness of the Controlled Substance Act and other legislation controlling drug abuse has been widely discussed, but no consensus has been reached (The Strategy Council on Drug Abuse 1979; Kaxlon 1970; Joint Committee on New York Law Evaluation 1978; Select Committee on Narcotics Abuse and Control 1977; President's Commission on Mental Health 1978, pp. 2103-40). There has been no known attempt to assess the effect of such legislation on highway safety.

Driver-control countermeasures include enforcement, adjudication, and sanctions related to violations of laws that proscribe driving while impaired by drugs. The approach parallels that used to control alcohol-impaired drivers but is far less developed because of the lack of emphasis placed on it by countermeasure agencies. This lack of emphasis is due primarily to the inherently greater complexity of the drug and driving problem and the as yet undetermined role of drugs other than alcohol in highway traffic crashes.

In contrast to drug-control countermeasures, driver-control countermeasures have their basis almost entirely in state statutes and local ordinances. There are no national statutes or regulations proscribing drug use while driving. The Uniform Vehicle Code (UVC) (National Committee on Uniform Traffic Laws and Ordinances 1968) contains model provisions for state laws, but the states are not required to incorporate those provisions into their own vehicle codes. In general, driver-control statutes define the terms "drug" and "drug-impaired driver" (including drug/alcohol impairment), prohibit drug-impaired driving, set out evidence-gathering procedures, and include the sanctions that may or must be imposed upon convicted drivers.

Past comparisons of state statutes with the UVC have revealed considerable variations between the provisions of state drug and driving statutes and regulations and those of the UVC (Nichols 1971). This report provides a more recent comparison later in this chapter. (Current versions of Traffic Laws Annotated [TLA] [National Committee on Uniform Traffic Laws and Ordinances 1972] and Driver Licensing Laws

Annotated [DLLA] [National Committee on Uniform Traffic Laws and Ordinances 1974], augmented by data from our own state-by-state analysis of state statutes, are used in the comparison.)

Some analysts have recommended drastic changes in the present laws. Many such changes would no doubt face serious constitutional, political, or practical difficulties if implemented and challenged. For example, Whitehead and Ferrence (1976) recommended law changes in Canada to permit random blood tests for drugs in drivers and recommended reducing the legal BAC limit to .04% w/v to deal with combined alcohol and other drug use. Forney and Richards (1975) concluded that traffic laws should be changed to permit the collection of blood in all traffic arrests.

Statutes and regulations also provide the legal basis for the operation of the other driver-control functions of the legal system. For example, a state's implied consent statute provides a tool for enforcement by specifying the conditions under which a motorist may be required to submit to a chemical test for drugs after being arrested for driving under the influence of drugs (DUID). (In this report, the term DUID refers generally to laws prohibiting drug-impaired driving.) A state's DUID law may refer to other statutes, for example, a controlled substance law that defines the drugs that are included in the DUID law. Thus, the statutory basis for drug and driving countermeasures is quite complex and cannot be determined by a simple analysis of a state's DUID law.

There is a close relationship between driver-control countermeasures for drugs and countermeasures for alcohol. Drug and driving countermeasures often follow the alcohol "analogy" but assume a secondary position to alcohol. Almost all state laws have included the prohibition against driving under the influence of drugs in the same statute as driving under the influence of alcohol, but this is not the case with respect to chemical testing. In 1962, the UVC was revised to include a separate provision requiring chemical tests of those suspected of driving while under the influence of alcohol. The chemical-test provision was added to the alcohol statute, and the drug provision was placed in a separate statute. A 1971 revision of the UVC expanded the chemical-test provision to include mandatory testing in drug and driving cases as well,

so the drug and alcohol provisions were again combined in the same statute. However, many states continue to provide for chemical testing for alcohol only.

DRUG CONTROL

As stated earlier, drug control is one of two principal ways in which government can act to reduce the incidence of drug-impaired driving. Drug control relates only indirectly to highway safety, which is one of a set of drug-related social problems, and involves taking action at a much earlier stage. Specifically, it restricts the availability of drugs themselves and thus reduces the number of opportunities for drug-impaired driving. This approach has long been used to control alcoholic beverages; for example, the times and places for legal beverage sales are specified by law, taxes are levied on beverages in part to discourage consumption, and purchasers must be above a designated minimum age (Distilled Spirits Council of the United States, Inc. 1977).

Comparison of Drug and Alcohol Control

Control over the manufacture, distribution, and use of drugs is exercised at both the federal and state levels. Drug control differs from alcoholic beverages control in several respects. First of all, since the Twenty-First Amendment ended national prohibition in 1933, control over the availability of alcohol has reverted almost entirely to the states. Federal control of alcoholic beverages consists largely of imposing taxes on manufacturers and importers. On the other hand, the manufacture and distribution of drugs is extensively regulated by federal law. Second, alcohol is a licit drug in most areas of the nation; except for minors and inebriates, all persons are permitted by law to purchase, possess, and consume alcohol beverages. Some drugs, however, are prohibited and are available only for medical research; other drugs are made available only for the purpose of medical treatment. Finally, although those who manufacture, distribute, and sell alcohol are required to be commercially licensed, no medical or other scientific expertise is required to obtain a liquor license. This is not the case with most drugs; those who distribute

prescription drugs to the general public must meet professional licensing criteria, which include degrees in medicine or pharmacy. Over-the-counter drugs, however, are distributed and sold much like alcohol.

Federal Drug Control Legislation

Federal control over drugs derives from two types of law. A summary of principal legislation dealing with drugs appears in Table 6-1. The first of these types is "pure food and drug" legislation, beginning with the Pure Food and Drug Act of 1906, which generally prohibited the adulteration or misbranding of substances. Control over drugs was increased by the Food, Drug, and Cosmetic Act of 1938, which required, among other things, that any new drug be proved "safe" before it could be marketed. The Drug Amendments of 1962, Public Law 87-781, required that new drugs be "effective" as well as safe. The 1962 legislation also provided for extensive federal regulation of pharmaceutical manufacturers, imposed restrictions on the testing of new drugs, and gave the federal government authority to withdraw existing drugs from the market if they are shown to be unsafe (Dowling 1971). Authority to enforce pure food and drug laws currently rests with the Food and Drug Administration (FDA), a federal administrative body created within the U.S. Department of Health, Education, and Welfare (DHEW).

The second type of law, "narcotics control" legislation, deals directly with the availability of narcotics and other dangerous drugs. A series of federal laws, beginning with the Harrison Narcotic Act of 1914 and culminating with the Controlled Substances Act of 1970, controlled the availability of opium, marijuana, and narcotic drugs, and imposed criminal penalties on illegal traffickers in those substances (Sonnenreich, Bogomolny, and Graham 1969). The general purpose of this legislation is to minimize the quantities of drugs of abuse that are available to persons who are prone to abuse them. Because these drugs can impair driving ability and are classified as controlled substances under the act, this legislation is of particular relevance to the subject of drug-impaired drivers.

TABLE 6-1

SUMMARY OF MAJOR DRUG CONTROL LEGISLATION--PART I

Pure Food and Drug Legislation (Dowling 1970)

NAME	DATE	EFFECT OF LEGISLATION	ENFORCING AGENCY
Pure Food and Drug Act	1906	Required standards for those drugs listed in official compendia, listing of certain ingredients, and if ingredients were listed, that list be correct.	Division of Chemistry (U.S. Department of Agriculture)
Sherley Amendment	1912	Classified a product as misbranded if claims in the labeling for therapeutic or curative effects were false and fraudulent. Required proof of deliberate intent to defraud.	Division of Chemistry
Food, Drug and Cosmetic Act	1938	(1)Definition of drug expanded. (2)Testing and proof of safety before marketing new drugs. (3)Certification of certain drug additives. (4)Labeling requirements: (a)adequate directions for use, (b)list all active ingredients as well as quantity or proportion of potentially harmful ingredients, (c)warnings if contents are habit forming or subject to misuse, (d)product was misbranded if false or misleading labeling--no proof of fraud needed. (5)Could move swiftly via injunction.	Food and Drug Administration (Established 1927)
	1941	Certification of batches of insulin by use of USP standards for strength, quality, and purity.	Food and Drug Administration
	1945	Certification of penicillin batches according to FDA developed standards.	Food and Drug Administration
Miller Amendment	1948	Jurisdiction over drugs that were adulterated or misbranded anywhere between manufacturer in one state and purchaser in another.	Food and Drug Administration
Kefauver-Harris Amendments (Public Law 87-781)	1962	(1)Registration and periodic inspection of drug manufacturers. (2)Records of prescription drug manufacturer and testing open to inspection. (3)Drug must be approved by FDA as both safe and effective, with the burden of proof on the manufacturer, to the satisfaction of the FDA. (4)Withdrawal of approval for older drugs if new information indicates safety or efficacy questions or presents an imminent hazard to the public health. (5)Informed consent of individuals taking drugs during clinical testing. (6)Certification of all antibiotics before marketing. (7)Authority to designate the official (generic) name for a new drug. (8)Labeling requirement that full information, as contained in the package insert or label, must be given to physicians upon request. (9)Advertising must contain a true statement with respect to safety, efficacy, and contraindications.	Food and Drug Administration (U.S. Department of Health, Education, and Welfare)

TABLE 6-1

SUMMARY OF MAJOR DRUG CONTROL LEGISLATION--PART II

Narcotic Control Legislation (Drug Enforcement Administration 1976; Sonnenreich, Bogomolny, and Graham 1969)

NAME	DATE	EFFECT OF LEGISLATION	ENFORCING AGENCY
Harrison Narcotic Act	1914	Control of opium and its derivatives but not synthetic equivalents.	Bureau of Narcotics (U.S. Treasury Department)
Marihuana Tax Act	1937	Control of the importation, cultivation, and use of marijuana.	U.S. Attorney General (U.S. Department of Justice)
Opium Poppy Act	1942	Regulation of opium poppy cultivation.	U.S. Attorney General
	1946	Opiates defined as drugs with properties like those of opium were brought under existing controls for opium.	U.S. Attorney General
Narcotic Drug Act	1956	Stiffer penalties for traffickers in narcotics and marijuana.	U.S. Attorney General
Manufacturing Act	1960	Control on legal supplies of narcotic drugs.	U.S. Attorney General
Drug Abuse Control Amendments	1965	Control of nonnarcotic abuse potential drugs, such as barbiturates,amphetamines.	U.S. Attorney General
Narcotic Addict Rehabilitation Act	1966	Removal of certain addicts from the criminal process to medically conducted rehabilitation programs. Treatment under this act is not available to persons addicted to nonnarcotic drugs.	U.S. Attorney General
	1967	Accession to the Single Convention on Narcotic Drugs(1961).	U.S. Attorney General
Controlled Substances Act (Public Law 91-513)	1970	Collection and conformance of the previous drug control regulations in one piece of legislation that provides the Attorney General, or his designee, with the authority to place drugs into the various schedules, after hearings and provision of scientific information by the FDA and NIDA.	Drug Enforcement Administration (U.S. Department of Justice)

The Controlled Substances Act, as its name implies, attempts to control the availability of drugs of abuse in three ways: first, by mandating registration and surveillance of drug handlers; second, by restricting the manufacture, distribution, import, export, and dispensing of drugs; and third, by imposing criminal sanctions on those who illegally traffic in, possess, or use controlled drugs (Vodra 1974). Drugs of abuse are classified into one of five "schedules" depending on their value in medical treatment, potential for abuse, and risk of creating a physical or psychological dependence. The criteria by which drugs are assigned to schedules are set out in Table 6-2. Schedule I drugs (which include LSD, marijuana, mescaline, peyote, as well as other hallucinogens, opiates, and opium derivatives) are deemed to have no currently accepted medical use and to have a high potential for abuse. These drugs cannot be used except in controlled research projects. Schedule II, III, and IV drugs are available by prescription only. Drugs in each of these three schedules have currently accepted medical use, have the potential for abuse, and pose the risk of physical or psychological dependence. A drug's relative potential for abuse and dependence determines the schedule in which it is placed: Schedule III drugs are deemed less dangerous than Schedule II drugs; those in Schedule IV are in turn less dangerous than those in Schedule III. Restrictions are placed on refilling prescriptions for drugs; these depend on the schedule to which the drug is assigned (Drug Enforcement Administration 1978). Schedule V consists of nonprescription narcotic drugs that have limited potential for abuse or dependence. These can be sold over the counter; however, purchasers must be at least eighteen years old and must sign for the drugs. The distribution regulations governing the five schedules of controlled substances are compared in Table 6-3.

Two federal agencies share the responsibility for scheduling drugs: one is the Drug Enforcement Administration (DEA), an agency of the U.S. Department of Justice; the other is DHEW. While the formal act of scheduling is carried out by DEA, the scientific and medical evaluation relating to a scheduling decision is carried out by DHEW personnel. The evaluation is conducted by various bureaus within DHEW (such as the

TABLE 6-2

CRITERIA FOR SCHEDULING CONTROLLED SUBSTANCES

(Drug Enforcement Administration 1976)

SCHEDULE NUMBER	POTENTIAL FOR ABUSE	ACCEPTED MEDICAL USE	SAFETY OR DEPENDENCE
I	The drug or other substance has a high potential for abuse.	The drug or other substance has no currently accepted medical use in treatment in the United States.	There is a lack of accepted safety for use of the drug or other substance under medical supervision.
II	The drug or other substance has a high potential for abuse.	The drug or other substance has a currently accepted medical use in treatment in the United States or a currently accepted medical use with severe restriction.	Abuse of the drug or other substance may lead to severe psychological and physical dependence.
III	The drug or other substance has a potential for abuse less than the drugs or other substances in Schedules I and II.	The drug or other substance has a currently accepted medical use in treatment in the United States.	Abuse of the drug or other substance may lead to moderate or low physical dependence or high psychological dependence.
IV	The drug or other substance has a low potential for abuse relative to the drugs or other substances in Schedule III.	The drug or other substance has a currently accepted medical use in treatment in the United States.	Abuse of the drug or other substance may lead to limited physical dependence or psychological dependence relative to the drugs or other substances in Schedule III.
V	The drug or other substance has a low potential for abuse relative to the drugs or other substances in Schedule IV.	The drug or other substance has a currently accepted medical use in treatment in the United States.	Abuse of the drug or other substance may lead to limited physical dependence or psychological dependence relative to the drugs or other substances in Schedule IV.

TABLE 6-3

CONTROL PROVISIONS OF THE CONTROLLED SUBSTANCES ACT OF 1970 (Vodra 1974)

CONTROL PROVISION	SCHEDULE I	SCHEDULE II	SCHEDULE III	SCHEDULE IV	SCHEDULE V
Registration	Required	Required	Required	Required	Required
Record Keeping	Separate from all others	Separate from all others	Must be readily retrievable	Must be readily retrievable	Must be readily retrievable
Production Quotas	Yes	Yes	No*	No*	No*
Distribution Restricted via	DEA-supplied order form	DEA-supplied order form	Valid DEA registration number	Valid DEA registration number	Valid DEA registration number
Dispensing Restricted via	Research use only	Written prescription signed by prescriber No refills	Written or oral prescription may give 5 refills in 6 months, if authorized	Written or oral prescription may give 5 refills in 6 months, if authorized	Over-the-counter written record of each sale must be kept. The purchaser must be 18 yrs old
Storage Security:					
(1)Manufacturer/ Distributor	Vault and surveillance	Vault and surveillance	Surveillance	Surveillance	Surveillance
(2)Pharmacy/ Physician	Safe or mixed with other stock	Safe or mixed with other stock	Mixed with other stock	Mixed with other stock	Mixed with other stock
Manufacturer/ Distributor Reports to DEA	Yes	Yes	Narcotic: Yes Nonnarcotic: No	No	Narcotic: Manufacturer
International Commerce:					
(1)Import	DEA permit required	DEA permit required	Narcotic: permit required Nonnarcotic: notify DEA	Narcotic: permit required Nonnarcotic: notify DEA	Narcotic: permit required
(2)Export	DEA permit required	DEA permit required	Narcotic: permit required Nonnarcotic: notify DEA	Narcotic: permit required Nonnarcotic: notify DEA	Narcotic: notify DEA
Penalties for Trafficking (First Offense**)	Narcotic: 15 yrs/$25,000 Nonnarcotic: 5 yrs/$15,000	Narcotic: 15 yrs/$25,000 Nonnarcotic: 5 yrs/$15,000	5 yrs/$15,000	3 yrs/$10,000	1 yr/$5,000

* Some of the products in these schedules are mixtures of Schedule II substances and other therapeutically active substances; therefore, these products are limited by the quotas set for Schedule II substances.

** Penalties are doubled for second and subsequent offenses (see Section 401 of the Act).

Bureau of Drugs and the Bureau of Veterinary Medicine) as well as the National Institute of Drug Abuse and the Controlled Substances Advisory Committee. DHEW's findings are then transmitted back to DEA, together with a recommendation regarding scheduling. As to medical and scientific matters, the DHEW evaluation is binding on DEA. DHEW's scheduling recommendation is binding only to the extent that if DHEW recommends against controlling a substance, DEA may not control it. It is also understood by DEA and DHEW that DEA cannot exceed the level of control recommended by DHEW. If, for example, DHEW recommends placing a drug in Schedule III, DEA may assign it to Schedule III, IV, or V (equal or lower levels of control) but may not place it in Schedule I or II (higher levels of control). Once DEA makes a scheduling decision, it will then follow normal administrative procedures to make its decision legally binding (Vodra 1974).

The Controlled Substances Act is enforced by both FDA and DEA. Enforcement activity includes supervising drug transactions, inspecting records, and ensuring that manufacturing quotas on certain controlled substances are observed. Most important, however, is the criminal prosecution of violators. Severe penalties are prescribed by law for illegal traffickers (see Table 6-3). In addition, illegal possession or use of any controlled substance is a criminal offense; the first offense is a misdemeanor punishable by one year's imprisonment and a $5,000 fine.

State Drug Control Legislation

Although federal legislation is the primary means by which the supply of drugs of abuse is both limited and controlled, several classes of state legislation also control the availability of these drugs. The first of these are state controlled substances acts that are patterned after the federal statute discussed above. State statutes, like the Controlled Substances Act, classify drugs by schedules. Any variation between the federal scheduling and the state scheduling of a drug is resolved by following the more stringent of the two. For example, if a state statute places a drug in Schedule IV and a federal statute places the same drug in Schedule V, then the state regulation takes precedence for the activities of all

licensees handling that drug in that state.

Although they appear redundant, state controlled substances statutes are nonetheless necessary because state prosecutors and courts cannot enforce federal narcotics laws. In practice, federal narcotics activity has, owing to lack of resources, concentrated only on large-scale traffickers and some users. Additionally, some states have chosen to prescribe different sanctions for violators than do the federal statutes. Typically, these have included more severe sanctions for major traffickers, as was the case in New York (National Institute of Law Enforcement and Criminal Justice 1978), or more lenient sanctions for simple posession or use of marijuana, as is the case in California, Oregon, Ohio, and a number of other states.

Second, federal laws authorize physicians, dentists, and pharmacists to dispense certain controlled substances. However, medicine and pharmacy are generally regulated at the state, rather than the federal level. To practice in a regulated profession in a specific state, one must obtain a license from that state's appropriate licensing authority. In general, requirements for obtaining such a license include graduating from an accredited professional school, passing the licensing examination, completing an internship program, and showing proof of good moral character. In the case of pharmacists, licensing authorities have authority to regulate business practices such as the prices of prescription drugs. Professional licensing authorities, operating under authority granted them by law, also regulate the professional conduct of practitioners and have the power to discipline unethical or incompetent persons. These professional sanctions (which may include loss of one's license to practice), as well as criminal sanctions, are available to punish physicians or pharmacists who violate the restrictions placed on controlled substances.

Summary

Both federal and state laws restrict the manufacture, distribution, and use of drugs that can be abused. The drug-control laws that are most relevant to drug-impaired driving are controlled substances acts. The Federal Controlled Substances Act is concerned primarily with their

manufacture and distribution: it limits the former, regulates the latter, provides for supervision of both, and prescribes sanctions for violators. State law consists not only of controlled-substances acts (which are generally patterned after the federal act), but also laws and regulations that govern the practice of medicine and pharmacy. Such legislation in effect governs the distribution and use of drugs.

DRIVER-CONTROL LAWS

Driver-control countermeasures are based on specific legislation making it unlawful to drive under the influence of drugs. We refer to such legislation as **DUID laws.** The Uniform Vehicle Code has contained a model statute prohibiting driving under the influence of drugs since 1926. All state traffic codes contain similar statutes, although there is a great deal of variance among the states in the provisions of their statutes.

In addition, the UVC, as well as all state statutes, contains provisions that allow police officers, as part of their authority in an arrest for driving under the influence, to request that a driver submit to a chemical test for intoxication. These statutes usually state that a driver has, by the act of operating a vehicle on the highways, given his consent to otherwise lawful chemical tests for the presence of alcohol (and possibly other drugs). For that reason they are commonly referred to as **implied consent** laws. Implied consent legislation specifies the conditions under which a police officer can request a test, sets out testing procedures, identifies the tests that may be given, and provides penalties (usually mandatory license suspension) for drivers who refuse tests.

This section discusses the different provisions contained in state DUID and implied consent statutes. During the course of this project legislative reference bureaus in all fifty states were contacted and asked to send a copy of their current DUID and implied consent laws, and copies of any recent legislative bills--both successful and unsuccessful--attempting to change either of the laws. Characteristics of state DUID and implied consent laws were then compared with the Uniform Vehicle Code. With respect to the DUID laws, the characteristics compared were:

- location (within the statute) of the DUID law;
- definition of "drug";
- definition of "drug-impaired driver";
- impairment as a result of a combination of alcohol and other drugs;
- permissibility of using licit drugs while driving; and
- punishment for conviction of DUID.

Characteristics of state implied consent laws that were compared with the UVC were:

- provisions for obtaining body fluid specimens for chemical analysis for drugs other than alcohol; and
- provisions allowing the use of the chemical analyses in the prosecution of drivers arrested for DUID.

To present these comparisons we first briefly discuss the UVC provisions applicable to DUID and then present the variations in the state laws by showing how many states are in conformity or at variance with the UVC provisions. A final section discusses the significance of state controlled substances laws with respect to driver control laws.

DUID Laws

Uniform Vehicle Code. The following are the applicable UVC provisions that make it unlawful to drive under the influence of drugs:

- § 11-902(a)3 states that: "A person shall not drive or be in actual physical control of any vehicle while . . . under the influence of any drug to a degree which renders him incapable of safely driving."
- § 11-902(a)4 states that: "A person shall not drive or be in actual physical control of any vehicle while . . . under the combined influence of alcohol and any drug to a degree which renders him incapable of safely driving."
- § 11-902(b) prohibits any person charged with driving under the

influence of drugs from using the fact that he has been legally entitled to use the drug as a defense to such a charge.

- § 11-902(c) of the UVC sets forth the penalties for conviction of DUID. The range of allowable penalties is the same as for driving under the influence of alcohol and includes a jail term of ten days to one year and a fine of $100 to $1,000 for a first offense. For a second or subsequent conviction the UVC calls for a jail term of ninety days to one year and a fine of not less than $1,000.

It is important to note that the terms "under the influence" and "renders . . . incapable of driving safely" as used in the UVC are not well-defined behaviorally. Thus the degree to which the effects of a drug influence behavior, and the kind of driving behavior indicating an inability to drive safely, are matters of judgment and are subject to different interpretations.

A number of revisions have been made in the DUID provisions contained in the UVC. The original DUID provision only prohibited driving under the influence of narcotic drugs. In 1944, the term "any drug" was added to the statute, and in 1968 the term "narcotic drugs" was dropped because the term "any drug" included narcotic drugs. The 1944 and 1968 revisions to the UVC reflected the realization that there existed nonnarcotic substances that were capable of impairing driving ability. In 1971, two major revisions were made to the UVC. First, reference to habitual users of narcotic drugs was dropped, leaving only the wording "persons under the influence." Second, the provision making it unlawful to drive under the combined influence of drugs and alcohol was added. An additional provision that the National Committee on Uniform Traffic Laws and Ordinances will consider for inclusion in the UVC in the near future is one that prohibits driving under the influence of a combination of drugs other than alcohol. As the statute presently reads, the only combination that is illegal is alcohol plus another drug.

State Variations. State DUID laws vary a great deal with respect to the Uniform Vehicle Code. For ease of discussion each characteristic of the UVC provision is analyzed in terms of the number of state DUID laws

that either conform to or vary from it.

Location of DUID Law. Twenty states follow the UVC and include the DUID provision in the same statute that prohibits driving under the influence of liquor (DUIL), but in a separate subsection. Twenty-four states include the DUID provision in the same section as the DUIL provision, generally in the same sentence. (In this report, the term DUIL refers generally to alcohol-impaired driving.) Only a small number of states, six, place the DUID law in a section separate from the alcohol law.

That the preponderance of states place the DUID provision in the statute prohibiting driving under the influence of alcohol indicates the degree to which alcohol and other drugs are thought of together, in impairing the ability to drive. Although most states tend to place alcohol and other drugs together in their driving statutes, many states seem not to acknowledge that alcohol is a drug. A large number of state statutes prohibit driving under the influence of **alcohol or any drug** when a more accurate statement would be **alcohol or any other drug.** The UVC, in its statutory provisions, also does not explicitly recognize that alcohol is a drug.

Definition of "Drug." States vary a great deal in the types of drugs they prohibit in their DUID statutes. Thirty states have statutes that are broad enough to cover most if not all drugs. Eleven states, like the UVC, use the term "any drug" as the sole description. Six states follow the language of the pre-1968 UVC and prohibit driving under the influence of "narcotic drugs or any other drug" while four states combine a prohibition against "controlled substances and any other drug." Nine states have other definitions of drugs, but appear to include all types of drugs in the definition.

The rest of the states' statutes define "drug" in a variety of ways. Some use only the term "narcotic drug" or "controlled substances" while others use either of these terms in addition to other drug classifications or specifically named drugs. Typical drug classifications other than "narcotic drug" or "controlled substance" include "hallucinogenic or

hypnotic drugs" or "central nervous stimulants." Commonly used specific drugs include marijuana, barbiturates, and toluene (model glue). Table 6-4, Column A indicates whether each state DUID statute applies to any drug, and, if not, the drug to which it applies. Table B-1 in Appendix B provides a more detailed listing of the drugs or drug classifications contained in each state statute.

In some states, primarily those that include the term "controlled substances" in their DUID statutes, the definition of "drug" is derived from the state's controlled substances act. Thus, the list of controlled substances is incorporated into the DUID law in its entirety. A complete listing of the drugs included in each state's controlled substances act is beyond the scope of this report; however, most state laws are, as mentioned before, patterned after the federal act, and they include marijuana and most other commonly used drugs that impair driving ability.

In states where the controlled substances act is incorporated into the DUID statute, gaps may exist in the law. Such noncontrolled substances as over-the-counter cold remedies and sleeping aids might result in impairment of driving ability and yet be outside the provisions of the DUID law.

The definition of the term "drug" in DUID statutes has been the subject of recent legislative action in a number of state legislatures. Recent attempts to change the definition (both successful and unsuccessful) include the following:

- The Tennessee legislature recently attempted to change the definition of "drug" from its present rather long and unwieldy definition to "any drug defined as a controlled substance," but this provision was amended out of the bill that contained it.

- Recently Virginia removed marijuana from its controlled substances list, but this does not appear to have had an effect on the enforcement of driving under the influence of drugs because the DUID statute refers to "any self administered . . . drug of whatsoever nature."

- Texas recently amended its DUID law, changing the definition of "drug." Previously the language had been "any narcotic drug or any other drug." The language now

TABLE 6-4

SUMMARY OF STATE DUID LAW CONFORMITY WITH UNIFORM VEHICLE CODE (UVC) PROVISIONS

STATE	A APPLIES TO ANY DRUG? UVC §11-902.1 (a)(3): YES	B APPLIES TO ALL COMBINATIONS OF ALCOHOL AND DRUGS?[a] UVC §11-902.1 (a)(3): YES	C MAY OFFICER DESIGNATE BLOOD TESTS? UVC §6-205.1 (a): YES	D MAY TWO OR MORE TESTS BE ADMINISTERED? UVC §6-205.1 (a): YES	E MAY SAMPLES BE ANALYZED FOR DRUG CONTENT? UVC §6-205.1 (a): YES
Alabama	NO[b]	NO	NO[g]	YES	NO
Alaska	NO[c]	NO	NO[h]	YES	NO
Arizona	YES	NO	NO[h]	YES	NO
Arkansas	YES	NO	NO[g]	YES	NO
California	YES	YES(1971)	NO[i]	NO	NO
Colorado	YES	NO	NO[g]	NO	NO
Connecticut	YES	YES(1971)	NO[i]	NO	YES
Delaware	YES	YES(1979)	YES	NO	NO
Florida	NO[c]	NO	NO[h]	NO	NO
Georgia	YES	YES(1971)	YES	YES	YES
Hawaii	YES	NO	NO[i]	NO	NO
Idaho	YES	YES(1971)	NO[z]	NO	NO
Illinois	YES	NO	NO[h]	NO	NO
Indiana	NO[c]	NO	NO[z]	NO	YES
Iowa	YES	YES(1979)	NO[g]	YES	NO
Kansas	YES	NO	YES	NO	NO
Kentucky	YES	NO	YES	NO	NO
Louisiana	NO[d]	NO	YES	YES	NO
Maine	YES	NO	NO[i]	NO	NO
Maryland	YES[c,d]	YES(1979)	NO[z]	NO	NO
Massachusetts	NO	YES(1979)	NO[h]	NO	NO
Michigan	NO[c]	YES(1971)	NO[j]	YES	NO
Minnesota	NO[c]	YES(1971)	NO[g]	NO[k]	YES
Mississippi	YES	NO	NO[h]	YES	NO
Missouri	YES	NO	NO[h]	NO	NO
Montana	YES	NO	YES	NO	NO
Nebraska	YES	NO	NO[g]	NO[l]	NO
Nevada	YES	NO	NO[g]	NO	NO[m]
New Hampshire	NO[c]	NO	YES	YES	YES
New Jersey	NO[d]	NO	NO[h]	YES	NO
New Mexico	YES	NO	NO[h]	YES	NO
New York	YES	NO	NO[z]	NO[l]	YES
North Carolina	YES	NO	YES	YES	NO
North Dakota	NO[b]	NO	YES	YES	NO
Ohio	NO[e]	YES(1971)	YES	YES	NO

TABLE 6-4

SUMMARY OF STATE DUID LAW CONFORMITY WITH UNIFORM VEHICLE CODE (UVC) PROVISIONS (Continued)

STATE	A APPLIES TO ANY DRUG? UVC §11-902.1 (a)(3): YES	B APPLIES TO ALL COMBINATIONS OF ALCOHOL AND DRUGS?[a] UVC §11-902.1 (a)(3): YES	C MAY OFFICER DESIGNATE BLOOD TESTS? UVC §6-205.1 (a): YES	D MAY TWO OR MORE TESTS BE ADMINISTERED? UVC §6-205.1 (a): YES	E MAY SAMPLES BE ANALYZED FOR DRUG CONTENT? UVC §6-205.1 (a): YES
Oklahoma	YES	NO	NO[i]	YES	NO
Oregon	NO[f]	YES(1971)	NO[h]	NO	NO
Pennsylvania	NO[c]	YES(1971)	NO[h]	NO	NO
Rhode Island	NO[d]	YES(1971)	YES	NO	YES
South Carolina	YES	NO	NO[h]	NO	NO
South Dakota	NO[c]	YES	NO[z]	NO[l]	NO
Tennessee	NO[d]	NO	NO[z]	NO	YES
Texas	NO[c]	NO	NO[h]	YES	NO
Utah	YES	YES(1971)	YES	YES	YES
Vermont	YES	YES(1971)	YES	NO[z]	YES
Virginia	YES	NO	NO[i]	NO	NO
Washington	YES	NO	NO[h]	YES	NO
West Virginia	YES	YES(1971)	NO[g]	NO	NO
Wisconsin	NO[c]	NO	YES	YES	YES
Wyoming	NO[c]	YES(1971)	YES	NO	NO

[a] The 1971 UVC prohibited driving while under the influence, etc., of a combination of alcohol and a drug. A 1979 UVC amendment also prohibited driving while under the influence, etc., of a combination of two or more drugs. States in conformity with either version are listed, with the particular version noted in brackets.

[b] Only narcotic drugs are included within the DUID definition of "drug."

[c] Only controlled substances (as defined by state law) are included within the DUID definition of "drug."

[d] Only those substances or classes of substances listed in the DUID statute are included within the DUID definition of "drug."

[e] Only "drugs of abuse" (not further defined) are included within the DUID definition of "drug."

[f] Only narcotic drugs and "dangerous drugs" (not further defined) are included within the DUID definition of "drug."

[g] The driver may refuse a blood test and instead take another test designated by the officer.

[h] The only chemical test authorized by law is the breath test.

[i] The driver may choose from among available tests.

[j] The driver may demand a breath test in lieu of a blood or urine test.

[k] State law provides for prearrest screening tests, but the test may be refused without penalty.

[l] State law provides for prearrest screening tests, but those tests apply to alcohol only.

[m] Chemical analysis is authorized only for the presence of controlled substances.

[z] Statute is ambiguous or does not address this point.

reads "a controlled substance or drug," with "controlled substance" and "drug" both defined later in the statute as those included in the Texas controlled substances statute.

Persons Liable Under the DUID Statute. Thirteen states have provisions similar to the old UVC provision prohibiting "habitual users" from driving. Most of these states limit this provision to habitual users of narcotic drugs or controlled substances with an additional provision prohibiting driving under the influence of other drugs included in their statute. Two states apply the habitual-user provision to substances other than narcotic drugs or controlled substances. Kansas prohibits habitual users of narcotic, hypnotic, somnifacient, or stimulating drugs from driving, while Rhode Island prohibits from driving habitual users of intoxicating liquor, narcotic drugs, barbiturates, toluene, or any central nervous stimulant as defined by its state drug code. In addition, California prohibits anyone who is **addicted** to any drug from driving. An exception is made for participants in an authorized methadone maintenance program. The use of the term **"addicted"** is very close to the term **"habitual user."**

All states, including those with habitual user provisions, prohibit persons who are under the influence of drugs from driving. Almost all of the states use the term "under the influence" in their statute. Missouri prohibits persons from driving in a **"drugged condition,"** while New York prohibits a person from driving "while his ability . . . is impaired."

Almost half of the states follow the lead of the UVC and add some form of phrase, such as "rendered incapable of safely driving." Table 6-5 lists by state the types of impaired persons who are prohibited from driving. The table shows that twenty-six states use no description beyond "under the influence." Those states that use the language "renders incapable of safely driving" use it in different contexts. Ten states apply this phrase to all drugs in their statute while nine states apply it only to drugs other than narcotic drugs or controlled substances. Variations on this wording include Hawaii's "renders incapable of operating . . . in a careful and prudent manner" and North Carolina's "to such a degree that

TABLE 6-5

DEFINITIONS OF DRIVER IMPAIRMENT IN STATE STATUTES

STATE	UNDER INFLUENCE ONLY	UNDER INFLUENCE + RENDERS INCAPABLE OF SAFELY DRIVING--APPLIES TO ALL DRUGS IN STATUTE	UNDER INFLUENCE + RENDERS INCAPABLE OF SAFELY DRIVING--APPLIES ONLY TO NON-NARCOTIC DRUGS	UNDER INFLUENCE + RENDERS INCAPABLE OF SAFELY DRIVING--APPLIES TO ALL DRUGS EXCEPT CONTROLLED SUBSTANCES	UNDER INFLUENCE + OTHER DEFINITION OF IMPAIRMENT--APPLIES TO ALL DRUGS IN STATUTE	UNDER INFLUENCE + OTHER DEFINITION OF IMPAIRMENT--APPLIES ONLY TO NON-NARCOTIC DRUGS	UNDER INFLUENCE + OTHER DEFINITION OF IMPAIRMENT--APPLIES TO ALL DRUGS EXCEPT CONTROLLED SUBSTANCES
Alabama	X						
Alaska	X						
Arizona		X					
Arkansas				X			
California	X						
Colorado			X				
Connecticut	X						
Delaware	X						
Florida					X		
Georgia		X					
Hawaii					X		
Idaho			X				
Illinois			X				
Indiana	X						
Iowa	X						
Kansas			X				
Kentucky					X		
Louisiana	X						
Maine	X						
Maryland							X
Massachusetts	X						
Michigan	X						
Minnesota	X						
Mississippi	X						
Missouri	X						
Montana			X				
Nebraska	X						
Nevada		X					
New Hampshire	X						
New Jersey	X						

TABLE 6-5

DEFINITIONS OF DRIVER IMPAIRMENT IN STATE STATUTES (Continued)

STATE	UNDER INFLUENCE ONLY	UNDER INFLUENCE + RENDERS INCAPABLE OF SAFELY DRIVING--APPLIES TO ALL DRUGS IN STATUTE	UNDER INFLUENCE + RENDERS INCAPABLE OF SAFELY DRIVING--APPLIES ONLY TO NON-NARCOTIC DRUGS	UNDER INFLUENCE + RENDERS INCAPABLE OF SAFELY DRIVING--APPLIES TO ALL DRUGS EXCEPT CONTROLLED SUBSTANCES	UNDER INFLUENCE + OTHER DEFINITION OF IMPAIRMENT--APPLIES TO ALL DRUGS IN STATUTE	UNDER INFLUENCE + OTHER DEFINITION OF IMPAIRMENT--APPLIES ONLY TO NON-NARCOTIC DRUGS	UNDER INFLUENCE + OTHER DEFINITION OF IMPAIRMENT--APPLIES TO ALL DRUGS EXCEPT CONTROLLED SUBSTANCES
New Mexico			X				
New York	X						
North Carolina						X	
North Dakota	X						
Ohio	X						
Oklahoma				X			
Oregon	X						
Pennsylvania		X					
Rhode Island	X						
South Carolina	X						
South Dakota		X					
Tennessee	X						
Texas		X					
Utah		X					
Vermont		X					
Virginia	X						
Washington		X					
West Virginia				X			
Wisconsin	X						
Wyoming		X					

his physical or mental faculties are appreciably impaired." States apply these restrictions in different contexts. Three apply it to all drugs in their statute while two apply it only to drugs other than narcotic drugs or controlled substances.

The distinctions discussed above become important when a state attempts to enforce its DUID law against drivers who might be under the influence of any of the broad spectrum of drugs available today. A statute that only proscribes driving "under the influence" is vague. For example, a person treated for a medical condition may be taking effective dosages of prescribed psychoactive drugs and thus could be considered "under the influence." But that person may be better able to drive safely, particularly if the condition can itself impair driving. A statute that also includes "renders . . . incapable of driving safely" or similar wording clarifies the kind of drug-impaired driving that is prohibited. Unlike DUIL statutes, DUID statutes do not identify drug concentrations in body fluids presumptive of driving under the influence; therefore, DUID statutes require as much clarity as possible.

Other types of drug-related driving impairment may not be covered by existing language in DUID statutes. For example, a person may not be "under the influence" of drugs but still be rendered "incapable of driving safely." Persons suffering the effects of withdrawal from depressant or stimulant drugs may be greatly impaired. Persons under treatment for potentially impairing medical conditions (such conditions include narcolepsy, epilepsy, diabetes, and some cardiovascular ailments) may take inadequate dosages and relapse while driving. In the latter examples, impaired driving would result from a **failure** to be under the influence of prescribed therapeutic drugs. Note, however, that even if an individual's driving behavior does not fall under the DUID statute, it still may be prohibited by any of a variety of other traffic laws, such as those dealing with reckless or careless driving, or some other moving violations.

Combination of Drugs and Alcohol. Many law enforcement personnel and prosecutors believe that a significant number of people drive after taking alcohol and another drug, often marijuana, and that a statute

prohibiting the combination of the two would be a valuable enforcement tool in addition to statutes prohibiting alcohol- or drug-impaired driving. Table 6-4, Column B lists by state whether the DUID statute currently provides for a combination of drugs, a combination of drugs and alcohol, or both. As the table reveals, nineteen state statutes contain provisions prohibiting driving under the influence of a combination of drugs and alcohol. In those states that do not, the prosecutor must choose between prosecuting the DUIL offense or the DUID offense. State criminal procedure laws vary as to whether both offenses may be charged in the alternative. As evidenced by a South Carolina case, State v. Sheppard, some courts may, in the absence of a statute making it unlawful to drive under the combined influence of drugs and alcohol, find that the statute covers the situation anyway. Clearly, though, the most effective way to deal with the problem is to enact a provision in the law prohibiting driving under the influence of any combination of drugs and alcohol.

Legal Use of Drugs. A person driving under the influence of drugs (including alcohol) is a highway safety hazard whether he is using the drugs legally or not. Most states either contain an express provision similar to that of the UVC—that the legal use of drugs is not defense to DUID—or contain no provision at all. Some states, however, appear to permit driving while under the influence of licit drugs other than alcohol. Indiana's DUID law prohibits driving "**unlawfully** under the influence of . . . drugs," while the Iowa DUID statute states that it does not apply to persons taking a drug prescribed by a doctor and in accordance with directions of the doctor. The exception does not apply if the driver has consumed alcohol. Maryland's law contains a provision stating that a defense to drug-impaired driving is available if the person "was unaware that the drug would render him incapable of safely driving a vehicle." Arizona's law contains an interesting if not redundant provision: if the drug in question is prescribed it must be shown that the drug rendered the person incapable of driving safely. This provision is no different, however, from the part of Arizona's statute prohibiting driving under the influence of "any other drug to a degree which renders . . . incapable of

safely driving." To prove the case, prescription drug or not, the same degree of impairment must be shown. At present, however, no standard of impairment has been developed that would allow measurement of the "degree which renders . . . incapable of safely driving." Only qualitative behavioral tests have been applied.

Punishment for Conviction of DUID. The range of punishments, including fine, jail, driver's license suspension, and treatment requirements, varies from state to state, but in most states, and in the UVC, the allowable range of sanctions is the same for drug-impaired as well as alcohol-impaired driving. In Mississippi, the range of fines is different for convictions of DUIL than for DUID: for DUIL the range is $50 to $500, while for DUID it is $100 to $1,000; also, for a second or subsequent conviction of DUID, the license revocation is not limited to two years, as with convictions of a second or subsequent DUIL. In Arkansas, for conviction of DUID, there is a mandatory term of imprisonment of ten days to one year, while for conviction of DUIL, the jail term is discretionary for up to one year. Colorado is the only other state where statutory sanctions differ for DUID and DUIL. There, conviction of DUIL is a class I offense, while conviction of DUID is a more serious class II offense.

In general it may be said that in almost all instances the statutorily permissible sanctions for DUID and DUIL are the same. In the few states where they differ, the DUID sanctions appear to be more severe. However, because of the wide range of sanctions that can be imposed on both DUIL and DUID offenders in most jurisdictions, any meaningful comparison of sanctions for the two offenses must be obtained from actual sanctioning practices of the courts and driver-licensing authorities.

Relationship to Other Laws. Laws proscribing driving under the influence of drugs can be seen as the chief countermeasure to that behavior. Two other laws have a direct relationship to DUID laws: implied consent laws and drug definition laws. It is the interaction with these other laws that determines how effective a DUID law is in

supporting driver-control activities.

All states have implied consent statutes. As stated earlier, these laws allow a police officer to obtain a specimen for chemical analysis under penalty of driver's license suspension or revocation. The implied consent statute can be important to the enforcement of DUID laws because it can provide the officer with an effective means of obtaining evidence of the type and amount of drug in the driver's blood. Without such evidence, prosecutors have found it extremely difficult to prove that a person was driving while under the influence of drugs.

State laws defining drugs are also important to the operation of a DUID law. Some states, such as Texas, define the use of the term "drug" in the DUID law to mean any drug in the controlled substances law, which is completely separate from the traffic code. If a particular drug does not appear on the state's list of controlled substances, then driving under the influence of the drug is not a violation of the DUID law. In such a case, a police officer is forced to arrest or to cite for another offense (such as reckless or careless driving) or to take no enforcement action at all.

Implied Consent Laws

Uniform Vehicle Code. The following are the applicable provisions of the UVC implied consent law that make it possible for a police officer to obtain a body fluid sample from a driver arrested for DUID, have it analyzed for drugs, and use the results of that analysis in court to prove the offense of DUID:

- § 6-205.1(a) states that: "Any person who operates a motor vehicle upon the highways of this State shall be deemed to have given consent, subject to the provisions of § 11-902.1 to a chemical test or tests of his blood, breath, or urine for the purpose of determining the alcohol or drug content of his blood or arrested for any offense arising out of the acts alleged to have been committed while the person was driving or in actual physical control of a motor vehicle while under the influence of alcohol or any drug. The test or tests shall be administered at the direction of a law enforcement officer having reasonable grounds to believe the person to have been

driving or in actual physical contol of a motor vehicle upon the highways of this state while under the influence of alcohol or any drug. The law enforcement agency by which such officer is employed shall designate which of the aforesaid tests shall be administered."

- § 11-902.1(a) of the Code provides: "Upon the trial of any civil or criminal action or proceeding arising out of acts alleged to have been committed by any person while driving or in actual physical control of a vehicle while under the influence of alcohol or drugs, evidence of the amount of alcohol or drug in a person's blood at the alleged time, as determined by a chemical analysis of the person's blood, urine, breath, or other bodily substance, shall be admissible."

- § 11-902.1(c) provides that: "If a person under arrest refuses to submit to a chemical test under the provisions of § 6-205.1, evidence of refusal shall be admissible in any civil or criminal action proceeding arising out of the acts alleged to have been committed while the person was driving or in actual physical control of a motor vehicle while under the influence of alcohol or drugs."

State Variations. As with DUID laws, state implied-consent statutes vary a great deal with respect to the provisions of the implied consent law found in the Uniform Vehicle Code. Below each characteristic of the UVC implied consent law is analyzed in terms of the number of states that either conform to or vary from it.

Chemical Tests Available Under Implied Consent Law. The type of chemical test that can be obtained under the implied consent law is important to the detection of drugs other than alcohol. Unlike alcohol, there is no realistic method for testing the breath for other drugs. To perform a chemical test for drugs other than alcohol, blood is the only body fluid appropriate for quantitative testing. An implied consent law, then, must contain a provision allowing a chemical test for blood--or at least some substance other than breath--to test for drugs other than alcohol. Without such a provision, the driver cannot be induced to provide an appropriate body fluid specimen under threat of license loss. The Uniform Vehicle Code recognizes this situation and permits a chemical test of blood, breath, or urine in its implied consent provision.

The states vary in the types of chemical tests authorized. Table 6-6 lists the tests included in each state's implied consent statutes. As indicated in the table, ten states provide only for breath tests in their implied consent laws. Those provisions preclude a police officer from using the threat of driver's license loss as a means of obtaining a body fluid specimen. The UVC provision for blood, breath, or urine tests is most commonly used, occurring in nineteen state statutes. Eleven states provide for the testing of blood or breath, but **not** urine. The remaining ten states allow chemical tests of blood, breath, urine, and, in addition, either saliva or other body substances or both. Thus, the most inclusive statute allows blood, urine, and saliva tests, in addition to breath.

Authority to Test for Drugs Other Than Alcohol. Even if an implied consent statute allows for the chemical analysis of blood or urine, another problem exists in most statutes. The vast majority of state implied consent statutes currently allow testing for **alcohol content** only. The trend on the part of legislatures to change implied consent laws to allow for analysis of drugs other than alcohol is relatively recent. The UVC added the provision in 1971. Following the UVC, twelve states have since enacted similar provisions. Still, thirty-eight states do not have provisions allowing implied-consent chemical testing for any drug other than alcohol. Table 6-7 lists the states that do and do not allow testing for drugs other than alcohol.

The absence of this provision represents a major weakness with respect to enforcement of DUID laws, because in most states police officers lack the power to compel a driver to choose between submitting to a test or losing his license. Instead, officers must choose between two alternatives. First, the officer may attempt to obtain the driver's voluntary consent to a test, although it is very unlikely that a driver who knows he is suspected of drug use will volunteer to be tested. Second, the officer may attempt to test over the driver's objection. It is unclear whether a court would hold this procedure constitutional. Moreover, involuntary testing is poor policy at best, since it contradicts the very purpose of implied consent legislation: replacing physical force with the threat of

TABLE 6-6

CHEMICAL TESTS SPECIFIED IN STATE IMPLIED CONSENT STATUTES

STATE	BREATH	BLOOD	URINE	SALIVA	OTHER BODILY SUBSTANCE
Alabama	X	X	X		
Alaska	X				
Arizona	X	X	X		
Arkansas	X	X	X		
California	X	X	X		
Colorado	X	X	X		
Connecticut	X	X	X		
Delaware	X	X	X		
Florida	X				
Georgia	X	X	X		
Hawaii	X	X			
Idaho	X	X	X	X	
Illinois	X				
Indiana	X	X	X		X
Iowa	X	X	X	X	
Kansas	X	X			
Kentucky	X	X	X	X	X
Louisiana	X	X	X		X
Maine	X	X			
Maryland	X	X			
Massachusetts	X				
Michigan	X	X	X		X
Minnesota	X	X	X		
Mississippi	X				
Missouri	X				
Montana	X	X	X		
Nebraska	X	X	X		
Nevada	X	X	X		X
New Hampshire	X	X	X		
New Jersey	X				

TABLE 6-6

CHEMICAL TESTS SPECIFIED IN STATE IMPLIED CONSENT STATUTES (Continued)

STATE	BREATH	BLOOD	URINE	SALIVA	OTHER BODILY SUBSTANCE
New Mexico	X	X			
New York	X	X	X	X	
North Carolina	X	X			
North Dakota	X	X	X	X	
Ohio	X	X	X		
Oklahoma	X	X			
Oregon	X				
Pennsylvania	X	X			
Rhode Island	X	X	X		
South Carolina	X				
South Dakota	X	X	X		
Tennessee	X	X	X		
Texas	X				
Utah	X	X	X		
Vermont	X	X			
Virginia	X	X			
Washington	X	X			
West Virginia	X	X	X		
Wisconsin	X	X	X		
Wyoming	X	X	X		

TABLE 6-7

STATE IMPLIED CONSENT STATUTES ALLOWING CHEMICAL TESTS FOR DRUGS

STATES ALLOWING	STATES NOT ALLOWING		
Connecticut	Alabama	Kentucky	North Dakota
Georgia	Alaska	Louisiana	Ohio
Indiana	Arizona	Maine	Oklahoma
Minnesota	Arkansas	Maryland	Oregon
Nevada	California	Massachusetts	Pennsylvania
New Hampshire	Colorado	Michigan	South Carolina
New York	Delaware	Mississippi	South Dakota
Rhode Island	Florida	Missouri	Texas
Tennessee	Hawaii	Montana	Virginia
Utah	Idaho	Nebraska	Washington
Vermont	Illinois	New Jersey	West Virginia
Wisconsin	Iowa	New Mexico	Wyoming
	Kansas	North Carolina	

license suspension as a means of obtaining driver compliance.

Recently state legislators have made numerous attempts, both successful and unsuccessful, to change their implied consent laws to allow for drug testing:

- A recent bill in the Maryland legislature proposed to change the implied consent law to allow for chemical testing of both drug and alcohol content. Currently, only alcohol content can be tested. The bill was defeated.

- A bill was introduced in the Texas legislature to change the implied consent law to allow for testing of drugs other than alcohol; it was defeated, according to a legislative research attorney, because of lack of adequate standards for determining impairment by drugs.

- A recent bill in the Louisiana legislature to change the implied consent law to allow chemical testing for drugs other than alcohol failed to pass by nine votes.

- Utah, in 1977, revised its implied consent law to provide for chemical testing for drugs other than alcohol.

- California is currently considering a bill to add the chemical analysis of drugs to its implied consent law. Another provision of this bill states that if a breath test shows a blood alcohol concentration (BAC) of .05% w/v or below, a police officer with reasonable grounds to believe the driver is under the influence of drugs may request a blood or urine test for analysis for drugs. If this bill is adopted in its current form it could serve as a model statute on which other states could base their implied consent provisions relating to drugs other than alcohol.

- Nevada recently enacted legislation tightening up its implied consent law with respect to drugs. The implied consent law previously allowed testing for drugs other than alcohol, but only when two criteria were met:

  -- no noticeable odor of alcohol was emanating from the body of the person **and**

  -- the presence of a controlled substance in the blood of the person was in issue.

  If these two criteria were met the driver was required to take a blood or urine test at risk of license loss. The new legislation removes the first criterion from the law and requires only that the presence of a controlled

substance be in issue.

- New Mexico recently amended its implied consent law to allow execution of a search warrant authorizing chemical tests for drugs or alcohol if there is probable cause to believe that the driver caused the death or likelihood of death of another or committed a felony while under the influence of alcohol or controlled substances. However, this statute only applies in extraordinary cases, such as serious or fatal accidents and major crimes. It would not apply to the typical arrest for drug-impaired driving.

As can be seen by these examples, some state legislators are attempting to change implied consent statutes to include testing for drugs other than alcohol, but most states still do not have such a provision.

Authority to Choose the Test To Be Given. If police are to obtain a body fluid specimen that can be analyzed for drugs, they must have the authority to choose the test to be given. Blood is the preferred body fluid for testing of drugs. If the choice is left to the driver, he can avoid drug analysis by requesting a breath test. Six states, California, Hawaii, Maine, Oklahoma, Pennsylvania, and Virginia, have absolute provisions allowing the driver to choose the test. The other states express or imply that the police officer has this authority, but in some states this authority is not absolute. For example, Colorado allows the **driver** to choose a blood test, but if he does not wish a blood test, then the **officer** may choose either breath or urine. In Michigan, the police officer may initially determine which test will be given, but the driver may defeat the officer's choice by demanding that only a breath test be given. If such a demand is made, the driver cannot be penalized for refusing another test. Some states, such as Pennsylvania and Washington, authorize tests of blood or breath in its implied consent law, but limit the police officer to designating a breath test unless the person to be tested is unconscious. Several states, including Alabama, Iowa, and West Virginia, allow the officer to designate the test but the driver may refuse to submit to a blood test as long as he takes any other test that the officer may choose. These provisions present a major impediment to

obtaining a body fluid specimen that can be tested for drugs. Table 6-4, Column C, indicates the authority of the officer to designate a blood test in each state.

Adding to the police officer's problem in requiring a test other than breath is the cumulative effect of the two previously discussed provisions of implied consent laws. Consider, for example, that only forty states even allow any test other than breath, no matter who designates it. Only twelve of these forty states authorize the implied consent testing for drugs other than alcohol. Thus, in only twelve states can a police officer request that a driver submit to a chemical test that can detect drugs other than alcohol. These states are: Connecticut, Georgia, Indiana, Minnesota, Nevada, New Hampshire, New York, Rhode Island, Tennessee, Utah, Vermont, and Wisconsin.

An issue related to the authority to designate the test is the officer's ability to obtain more than one test. The UVC provides that the driver impliedly consents to a **test or tests.** This would allow a police officer, after a breath test has been given, to obtain another test if the breath test raised the possibility of use of other drugs. Many states have similar provisions. In states that do not have this provision, the driver might satisfy the implied consent law by taking a breath test, after which a blood test cannot be obtained. Table 6-4, Column D, lists which states have a "test or tests" provision.

Evidential Use of Results of Chemical Test for Drugs. Ten states have provisions similar to the UVC, allowing results of chemical tests for drugs other than alcohol to be used as evidence. These ten states are also ten of the twelve states whose implied consent laws authorize testing for drugs other than alcohol. Utah and Vermont, the other two states having such a provision in their implied consent law, do not have a similar provision allowing the drug test results to be used as evidence. It can be argued, however, that a statute is not necessary where the chemical tests for drugs have been authorized by the implied consent statute.

North Carolina, although it is not one of the twelve states that allow

testing for drugs in its implied consent law, has a provision dealing with presumptions raised by blood alcohol content. It states "the provisions of this section shall not be construed as limiting the introduction of any other competent evidence, including **other types of chemical analysis**" (emphasis added). It can be argued that this provision permits the introduction, into evidence, of drug test results. Other states' chemical test and DUI statutes contain no provisions for the introduction of drug analysis into evidence. However, such a provision might be located elsewhere in the state's laws.

Evidential Use of Refusal to Submit to Chemical Test of Drugs Other than Alcohol. Only three states, New York, Utah, and Vermont, have provisions paralleling those of the UVC, allowing the prosecution to present evidence at the trial of the driver's refusal to submit to a chemical test for drugs other than alcohol. However, there are a number of states, including these three states, that permit the prosecution to present evidence that the driver refused to submit to a chemical test for alcohol.

Preliminary Breath Tests. Some states have provisions within their implied consent laws for a preliminary breath test (PBT) to measure alcohol intoxication. Such a test is given before a formal arrest and is almost always inadmissible in court as evidence of the driver's intoxication. Its primary function is to guide the officer in deciding whether to test further for alcohol impairment. Although the preliminary breath test is intended for use before the driver's arrest, the U.S. Constitution appears to require that an officer have **probable cause to arrest** the driver for DUI before he may require the driver to submit. This does not prohibit an officer from administering the PBT to a driver who requests a screening test, or who voluntarily agrees to take the test. The Uniform Vehicle Code does not contain a preliminary breath test provision, but it does recognize the existence of such a law among the states.

Still, most states' implied-consent statutes parallel those of the UVC

and require a formal arrest before any tests may be required of the driver. This requirement is statutory only--the Constitution does not require a formal arrest prior to testing. In states that do not require a formal arrest, such as North Carolina and Pennsylvania, an officer may, **with probable cause**, administer the PBT to eliminate alcohol as the cause of a driver's impairment and then--if the PBT shows little or no alcohol in the driver's body **and** if state law permits the administration of more than one test—formally arrest the driver and request another test for chemical analysis. Thus, a screening test, if it is based on probable cause and authorized by state law, can be important to the enforcement of DUID laws.

Not all of the states with a PBT law can use it to obtain chemical tests for drugs. To do so, the state must also have provisions in its implied consent law for the selection **by a police officer** of a test **other than breath** that is authorized to be tested **for drugs other than alcohol.** When the states that have preliminary breath tests are analyzed in terms of these three criteria, only Minnesota, New York, and Wisconsin satisfy all of the criteria (Indiana also satisfies the criteria with its prearrest chemical test statute). The other states that have PBT statutes fail to meet one or more of the three criteria. In those states the preliminary breath test has limited value in ultimately obtaining a body fluid sample that could determine the presence of drugs.

Liability for Obtaining Blood Sample. In most instances, if a chemical test other than of breath is performed, it is of the driver's blood. A practical constraint on obtaining drivers' blood samples is the occasional unwillingness of doctors or other health professionals to draw blood from an arrested driver for fear of being sued. Those who draw blood could be sued on either of two principal grounds: first, for **battery**, or physical contact with a driver without the driver's consent; and second, for **negligence**, if the drawing of blood is not properly done and injury results to the driver. All states shield the person drawing the blood at an officer's direction from any liability for battery. Only New York appears to establish an absolute immunity from suit (that is, from

negligence as well as battery), for the person drawing blood; there, the driver must instead sue the state for any negligent acts committed by the person drawing the blood. If such an immunity makes health professionals more willing to draw an arrested driver's blood, it can increase the frequency with which blood is drawn and consequently result in more chemical tests for drugs other than alcohol.

Drug Definition Laws

Drug definition laws are commonly called "controlled substances laws" or "controlled substances acts." In these laws, discussed earlier in the chapter, states define what drugs are subject to regulation. DUID laws in some states interact with controlled substance laws because the definition of the term "drug" in the DUID law will derive its meaning from the controlled substance law. In these states it is necessary to refer to the controlled substances law to determine which drugs are included in the DUID law.

SUMMARY

Laws relevant to drugs and highway safety are currently directed at two goals—drug control and driver control. **Drug control** laws exist at both the federal and state level that restrict the manufacture, distribution, and use of drugs capable of being abused. The laws that are more relevant to drug impaired driving are controlled substances acts. The Federal Controlled Substances Act as well as state controlled substance acts are concerned primarily with the manufacture and distribution of controlled drugs. State laws and regulations also govern the practice of medicine and pharmacy. All of these laws indirectly control the availability of drugs to drivers.

Driver control laws directed at drug impaired driving are similar to the laws directed at alcohol impaired driving. All states have laws prohibiting drug impaired driving (**DUID laws**). The model law prohibiting driving while under the influence of drugs, contained in the Uniform Vehicle Code, is the most complete set of provisions contained in a single

law. States such as Georgia, that have adopted the UVC provisions, have the most useful statutory tools for enforcing their DUID laws. Most state statutes do not have all of the provisions contained in the UVC. As a result, there are likely to be some weaknesses in their laws with respect to the enforceability of the DUID provisions. The following are typical problems:

- States that do not define the term "drug" in their DUID statute as "any drug," but instead limit it to a specific type of drug (e.g., "narcotic drugs") run the risk of omitting some drugs that may impair a person's driving ability from the prohibition of the DUID statute. Similarly, states that refer to a controlled substances law to define the use of the term "drug" in their DUID law run the similar risk of not including all possible drugs in the DUID law.

- States that do not include the wording "under the influence of any drug to a degree which renders incapable of safely driving" do not have as clear a law as they could have. A person may be "under the influence" of a prescribed drug, yet able to drive safely, especially if the condition for which the drug was prescribed can itself impair driving ability. By applying these two phrases to "any drug" the statute is as clear as possible.

- States that do not have a statute making it unlawful to drive under the combined influence of alcohol and other drugs are unable to deal effectively with the driver who is under the combined influence of drugs and alcohol, but not enough of either to warrant a charge of DUIL or DUID.

- States that allow as a defense to DUID charges the legal use of therapeutic drugs do not recognize that a person driving under the influence of drugs is a highway safety hazard whether the drug use is legal or illegal.

As with DUID laws, the **implied consent** provisions contained in the UVC are the most complete set of provisions contained in a single law. Most state statutes do not have all of the provisions contained in the UVC. The following are typical problems that result from the lack of these provisions:

- States that do not provide chemical tests other than breath in their implied consent law are unable to test for

drugs other than alcohol.

- States that do not include within their implied consent law the authority to test for drugs other than alcohol cannot use the implied consent law to determine the presence of drugs in a driver even though they are able to obtain a body fluid specimen other than breath.

- States that allow the driver to choose the type of chemical test to be taken may prevent a police officer from collecting a body fluid specimen that can be tested for drugs other than alcohol. In these states, a driver suspected of using drugs can request a breath test, thereby preventing analysis for drugs other than alcohol.

CHAPTER SEVEN
APPLICATION OF DUID LAWS

This chapter addresses the application of laws related to drugs and highway safety. A background section discusses the general nature of the process by which DUID laws are applied. The remainder of the chapter details the current practices and problems present in applying these laws. The discussion is based on a series of contacts made with persons who manage and operate the legal system agencies responsible for applying DUID laws.

The review and analysis of state DUID laws in Chapter Six indicated problems in their wording and intent. In contacts with operational agencies, many of these same problems were identified as constraints. In fact, the similarity of problems experienced or perceived by the different types of agencies contacted during this study point to the close interrelationship among the different functions of the Traffic Law System. Those functions are:

- Legislation,
- Enforcement,
- Adjudication, and
- Sanctioning (Jones and Joscelyn 1976).

For example, problems in the adjudication of DUID cases stem from constraints in enforcing DUID laws. In many instances, personnel in operational agencies were aware that specific problems at one stage of the process led to difficulty at other stages.

As a consequence, the reader may encounter some redundancy in the detailed presentation of findings that follows. We hope that the disadvantages of redundancy are outweighed by the advantages of fully reporting the experience of applying DUID laws from each of three perspectives--enforcement, adjudication, and sanctioning. To our knowledge, this has not been done before in the drug and driving

literature. The value of this approach lies more in appreciating the interactive role of operational agencies than in identifying problems related to DUID laws per se.

BACKGROUND

As mentioned in Chapter Six, the three mechanisms by which DUID laws are applied are enforcement, adjudication, and sanctioning.

Enforcement activities related to the control of drug-impaired drivers have not been discussed at any length in the literature. Anecdotal evidence suggests that enforcement procedures closely follow those that have been used for enforcing drunk driving laws. (See Jones and Joscelyn [1979a,b] for a summary description of drunk driving enforcement procedures.) The same may be said about adjudication and sanctioning practices (see also Jones, Joscelyn, and McNair [1979]).

With respect to enforcement, DUID countermeasures may have benefited from their close alliance with countermeasures for driving under the influence of liquor (DUIL). During this study, reports received from agencies that apply DUID laws indicated that NHTSA's Alcohol Safety Action Program (ASAP), though directed at the alcohol-impaired driver, has resulted in increased awareness of impaired driving in general, including drug-impaired driving.

Contacts with practitioners in earlier studies of alcohol-impaired driving countermeasures (for example, Jones, Joscelyn, and McNair 1979) have indicated that, in some instances, the increased enforcement directed at alcohol-impaired driving results in stopping more drivers who show no signs of alcohol use but who definitely are impaired by other drugs. Sometimes, the police then arrest those drivers for DUID. In addition, the indicators that police officers use to detect drunk drivers (e.g., driving too slow or too fast; hugging the center line or curb) have been applied equally to driving while under the influence of other drugs. Clearly though, the enforcement of DUID laws has been secondary to the enforcement of DUIL laws.

We have found a similar effect on the **adjudication** of DUID laws. The ASAPs have resulted in a greater awareness of impaired driving and

a refinement of techniques in the prosecution of alcohol-impaired driving. This enhances a prosecutor's ability to prosecute a DUID case, which generally requires the same proof of driver impairment as does DUIL. As with enforcement, however, there are special problems associated with DUID, such as lack of chemical tests for drug content and limited knowledge of how drug concentrations in blood relate to driver impairment.

Sanctioning of drivers convicted of DUID has also been very closely associated with DUIL. Statutes tend to provide for the same range of sanctions for both offenses, and treatment or education sanctions for DUID and DUIL are often applied in the same manner. The ASAPs have provided an impetus for setting up formal treatment referral systems for persons convicted of DUIL and, in some jurisdictions, drivers convicted of DUID are sent through the same system.

ENFORCEMENT OF DUID LAWS

To gain an understanding of the typical procedures used and problems faced by police in enforcement of DUID laws, we contacted police agencies throughout the country. State police agencies in all states were contacted, with forty-six state police agencies providing detailed information. In addition, twenty-three city police departments as well as the United States Air Force Security Police were contacted. In selecting the city police departments, a judgment sample was used, taking into account variables such as population, geographic location, and whether the city was previously a site of the former ASAP.

Every agency contacted was informally asked about its procedures for training officers to detect drug-impaired drivers as well as its DUID enforcement practices. This section presents the results of the information obtained in these contacts. First we discuss training for DUID enforcement given to police officers. Second, we examine typical enforcement practices reported by the police agencies. Next, we present estimates by respondents (and statistics where available) of the number of DUID arrests made per year. Finally, we discuss reported problems associated with DUID enforcement.

Training for DUID Enforcement

DUID enforcement is not usually taught as a separate block of instruction at police academies, either in the core curriculum or in advanced courses providing specialized training. Nor does it tend to be covered in in-service training sessions as a separate subject. Rather, in both the academy and in-service training, DUID is typically covered as a short subtopic, usually comprising about one-tenth of the total DUIL course. Police officials mentioned two primary reasons for this practice. First, since driving under the influence of alcohol is perceived as the main problem in highway safety, this emphasis is reflected in the training methods employed at police academies. Second, at present, no discrete set of driving behaviors has been identified that would enable the police to distinguish drug-impaired drivers from alcohol-impaired ones. The officer will look for the same cues to impaired driving. A case can be identified as DUID rather than DUIL only after the stop has been made and when the officer has had an opportunity to investigate. If alcohol involvement can be eliminated as a factor, or if alcohol is determined to be only a minor contributing factor in the driver's impairment, then the investigation is likely to move toward other drugs. Thus, police academies prefer to cover DUID as part of DUIL rather than separately. Instructors tend to explain only in passing how DUID arrest procedures can differ from DUIL arrest procedures.

Because DUID is usually touched on as a part of the DUIL instruction, the subject mattter is almost identical to DUIL. The instructor departs from the DUIL syllabus only when arrest procedures are different. The instructor may point out the differences as he goes along, or he may choose to cover all the particulars of DUID at one time. In either case, the approach to DUID is the same. The instructor discusses the state's laws on driving under the influence, outlining the various offenses contained in them and spelling out the elements of each offense. He then discusses the state's implied consent law, covering the presumptive levels of intoxication set out in it and the chemical tests that can be administered under its authority. Attention is also paid to what blood alcohol concentration constitutes a threshold below which a DUIL arrest

should not be made. If departmental policy prefers one chemical test over another, that will also be mentioned. The differences between DUID and DUIL generally receive most emphasis in the context of arrest procedures.

The Indiana State Police Academy course is typical of the instruction that police academies give on DUID. It teaches DUID as part of the DUIL course, which itself is taught as part of an eight-week block of instruction on traffic laws. The DUIL portion of that block is estimated to be about fifty hours. Of this time, about four hours are devoted to DUID. The DUID subtopic is presented between the material on the implied consent laws and the material on arrest procedures. The following points are made in covering DUID: Indiana has no means to test for drugs except with blood or urine specimens; blood specimens are difficult to obtain because, while officers are authorized to obtain them under the implied consent law, physicians who draw them or have them analyzed do not enjoy civil immunity for negligence; officers at the scene of an accident may capture escaping blood and have it analyzed if DUID is suspected; and if attending physicians draw a blood specimen for medical reasons, then the officer may try to secure a court order for its release. It is important to note that the course material does not cover the identification of drugs or the symptoms of drug use. Trainees are introduced to these topics in the course on narcotics law.

In addition to lectures and printed course materials, police academies make use of a variety of audio-visual aids (mainly films), and simulated field situations in their DUIL instruction. Some academies also use supervised patrols in the field, pairing the recruit with an experienced officer, as part of training. All these techniques are used for DUID as well as for DUIL.

The Los Angeles Police Department, working in conjunction with the California Office of Traffic Safety, recently received a grant to conduct an in-service training program on drug recognition. It includes training in drug use symptoms as well as recognition of types of drugs. While the initial sessions are aimed at narcotics officers, the program will be expanded to include traffic officers. It is expected that the program will

increase the traffic officer's ability to determine whether drivers are under the influence of drugs other than alcohol.

Enforcement Practices

All police agencies contacted indicated that the initial arrest sequence in DUID and DUIL cases is identical. Police usually become suspicious of erratic driving behavior, such as driving too fast or too slow, hugging the center line or curb, or making "jackrabbit" starts. It has not been determined that any driving behavior is unique to DUID, which would enable them to identify a priori an impaired driver as DUID rather than DUIL.

If the stopped driver acts as if he might be intoxicated, he is usually asked to get out of his car and perform a set of field sobriety tests. Indications of intoxication include slurred speech or a detectable odor of alcohol on the breath. If the field sobriety tests reveal impairment, the officer's attention will focus on driving under the influence. Three factors may direct his suspicion to DUID rather than DUIL. These are: (1) evidence of drugs or drug paraphernalia; (2) symptoms of impairment (such as slurred speech or inability to pass the field coordination tests) without alcohol odor; and (3) the driver's statement under questioning that he has been using drugs.

In states that authorize its use, a police officer **with probable cause to arrest** may give a preliminary breath test (PBT) before arresting a driver. The PBT can direct the officer's attention to the influence of drugs other than alcohol if the results of the PBT indicate little or no alcohol content in the driver's blood. The Lincoln, Nebraska Police Department has found the PBT to be an effective tool for DUID enforcement because it enables officers to eliminate alcohol impairment as a factor and concentrate on impairment by other drugs. The South Dakota Highway Patrol reports a different experience with the PBT. In South Dakota, if a driver submits to a PBT but then refuses an implied consent test once arrested for DUIL or DUID, courts often refuse to apply the sanctions that the implied consent law attaches to such a refusal. South Dakota courts reason that the police are entitled to only

one chemical test from the motorist, and deem the PBT to be that test, leaving the police with nothing but a screening test result that cannot be used as evidence. As a result, according to a spokesman for the South Dakota Highway Patrol, the PBT is no longer used. Other police agencies, such as Minneapolis and Orlando, Florida, indicated that even though they are authorized to use PBTs, they do not use them because of the expense involved. The Minneapolis police also point out that the twenty-minute "warm-up" time required for the ALERT® device (used for the PBT) makes an already long arrest process even longer.

After an arrest for either DUIL or DUID, the driver is usually taken to the stationhouse, where a chemical test is administered. In almost all of the jurisdictions contacted, the police agencies reported that the breath test is the first chemical test that is administered in over 90 percent of arrests. Some jurisdictions, such as the Birmingham, Alabama Police Department, offer only breath tests because that is all they are equipped to administer. In Denver and Minneapolis, officials for the police departments indicate that the administration of breath tests is videotaped by police to strengthen the case in court.

In jurisdictions with authority to select the test, the breath test is always the first choice. Table 7-1 lists the reasons given by jurisdictions for choosing tests other than breath and the frequency with which they were given. The primary reasons were a driver's being unconscious, fatally injured, or otherwise **unable** to take a breath test. Only six police agencies were likely to request an initial chemical test other than breath for suspicion of use of drugs. All but one of the fifty-three jurisdictions that in some instances administered a test other than breath noted that that test would be of the driver's blood.

Some police agencies contacted have procedures for determining drug impairment if the results of a breath test show that the driver is not under the influence of alcohol. In Natchez, Mississippi, if the BAC is below .05% w/v but the driver is obviously impaired, the suspect is taken to the local hospital for evaluation. A blood test is routinely taken as part of the evaluation and may be available to the prosecutor if the driver is subsequently charged with DUID. If Illinois State Police officers

TABLE 7-1

REASONS GIVEN BY POLICE FOR SELECTING CHEMICAL TESTS OTHER THAN BREATH

REASON FOR SELECTING	NUMBER OF JURISDICTIONS CITING THIS AS A REASON *
1. Suspects driver of use of drugs	6
2. Routine procedure	1
3. Fatal accident	31
4. Driver unable to provide breath sample	47
TOTAL	85

* A total of 53 jurisdictions responded to this question. Many jurisdictions offered more than one reason for collecting tests other than breath.

suspect drug use after the breath test is administered, they ask the driver for a voluntary blood sample. Their spokesman was unable to provide any statistics on how often a voluntary blood sample is supplied. Los Angeles City Police Department officers use an interesting procedure if they suspect drug impairment after giving the breath test. They administer an "admonishment" to the driver, telling him that he is not required to give the blood sample, but, if he does not, the refusal may be commented upon in court. This procedure is discussed in more detail in the materials dealing with the adjudication of DUID cases.

Police agencies that were contacted report various procedures for making the DUID versus DUIL arrest decision. Orlando Police Department officers arrest the driver for DUI and bring him to the station house for a breath test. After the results of the breath test are obtained, the officer will add either a "D" or an "L" to the citation. In several agencies, including the North Carolina Highway Patrol, officers regularly arrest for DUIL and then amend the charge to DUID if the breath test indicates that drugs other than alcohol may be involved. In states where the statute allows, the officer will arrest for the combined influence of drugs and alcohol and use the low BAC reading as evidence that other drugs were also involved. The California Highway Patrol reports such a procedure. In a number of jurisdictions, when officers suspect a combination of alcohol and other drugs to be involved, they arrest the driver for DUIL rather than DUID because DUIL is easier to prove in court.

Each of the above procedures is based on the observation that the degree of impairment is greater than that indicated by the amount of alcohol measured. The assumption that other drugs are also involved is dangerous, however, since many other factors, including fatigue and disease, not only can contribute to alcohol-impaired driving but also can impair driving by themselves. Using a low or negative (0% w/v) BAC reading as evidence to substantiate a DUID charge--absent specific, quantitative tests for other drugs—is not recommended.

Some police agencies often arrest the driver for an offense other than DUID even though the officer believes a DUID charge is appropriate.

The Florida Highway Patrol reports that often a driver suspected of DUID is arrested instead for "consumption of narcotics," because it is easier to prove. A substantial number of jurisdictions, including the Birmingham, Alabama Police Department, the Michigan State Police, the Rhode Island State Police, and the Utah State Highway Patrol, often cite the driver for a moving violation and drive him home because of the difficulties of proving DUID.

Frequency of Arrests for DUID

Arrest statistics for driving under the influence of drugs other than alcohol are not readily available in most states. As mentioned previously, state laws typically prohibit driving while under the influence of alcohol or other drugs, combining DUID and DUIL in a single statute. Thus, even though arresting officers might note on a citation that drugs other than alcohol were involved, police statistics in most states report both DUID and DUIL under the heading of DUIL. To get an accurate statistical picture of DUID, the original citations would have to be individually inspected to determine whether the arrest had been correctly classified as DUIL.

All police agencies that were contacted, however, clearly indicate that DUID arrests are infrequent compared to DUIL arrests. Records in three agencies that do keep separate DUID statistics tend to bear out this conclusion. In calendar year 1978, the Texas Department of Public Safety reported 40,621 arrests for driving while under the influence of alcohol, while only 311 arrests were made for driving while under the influence of drugs. Similarly, the Phoenix Police Department and the North Carolina Highway Patrol report their DUID and DUIL arrest statistics as shown in Table 7-2. The results of these tabulations suggest that DUID arrests are less than one percent of DUIL arrests.

Data from the Federal Bureau of Investigation's Uniform Crime Reports (UCR) (1975) showed that about one million reported arrests for DUIL occurred nationwide. Applying the 1 percent factor to this figure would yield a total of about 10,000 arrests per year nationwide for DUID. Of course, this is only a rough order-of-magnitude estimate. The current

TABLE 7-2

ARRESTS FOR DRIVING UNDER THE INFLUENCE OF DRUGS (DUID) AND DRIVING UNDER THE INFLUENCE OF LIQUOR (DUIL) IN PHOENIX, ARIZONA; NORTH CAROLINA; AND TEXAS

YEAR	NUMBER OF ARRESTS FOR DUID			NUMBER OF ARRESTS FOR DUIL		
	PHOENIX, ARIZONA	NORTH CAROLINA	TEXAS	PHOENIX, ARIZONA	NORTH CAROLINA	TEXAS
1976	N.A.	253	N.A.	N.A.	37,655	N.A.
1977	89	283	N.A.	9,627	37,053	N.A.
1978	84	290	311	11,232	42,391	40,621
January-June 1979	73	N.A.	N.A.	7,754	N.A.	N.A.
August 1979	N.A.	32	N.A.	N.A.	3,712	N.A.

N.A. Data presented were provided by the respective jurisdictions. Missing data were not readily available.

nationwide arrest rate for DUIL is not known, because the UCR no longer reports arrests for DUIL. Moreover, the relationship between the actual and reported arrest rate for DUIL is not known; it is also not known whether the 1 percent figure is representative of DUID arrests nationwide.

Some police departments indicate, however, that a simple comparison of DUID arrest statistics with DUIL arrest statistics does not give an accurate picture of the relation between drug- and alcohol-related DUI arrests. They believe a substantial number of DUIL arrests also involve drugs other than alcohol impairing agents. As discussed above, low BAC readings on breath tests lead to the suspicion of other drug involvement. Because DUID charges are more difficult to prove, however, many suspected "polydrug" cases are treated by the police as DUIL cases.

Two California studies support their conclusion that a substantial number of DUIL arrests involve drugs other than alcohol alone. In a study reviewed in detail in Chapter Four, Reeve (1979) reported data that suggest the use of two or more drugs could be a problem among impaired drivers. White et al. (1979) analyzed for depressant drugs blood samples from 1,819 drivers arrested for driving under the influence with a low or negative blood alcohol concentration. Analyses showed that 538 or 29.6% of the specimens tested were positive for sedative-hypnotic drugs. Unfortunately, neither study provides a basis for reliably estimating the prevalence of polydrug use among impaired drivers.

Problems in Making Arrests for DUID

All but two of the sixty-two police agencies that report making arrests for DUID experienced problems in making these arrests. This section discusses the problems with DUID enforcement reported by the police agencies. Many of the problems related to DUID laws (discussed in Chapter Six) were perceived and reported by these agencies, as discussed below.

Lack of Chemical Tests. All but one of the police agencies that report problems in making DUID arrests note as a major problem the lack of simple, reliable tests (comparable to the breath test for alcohol) in the

field or at the station. Police agencies indicate that a police officer's motivation to make DUID arrests would be greatly enhanced if simple tests were available.

Inability to Obtain Body Fluid Specimens that Can Be Tested for Drugs. While DUID cases are processed in court by prosecutors, police officers are instrumental in collecting evidence for the prosecution's case. Many police agencies indicate that if body fluid specimens suitable for drug analysis cannot be obtained from drivers arrested for DUID, the chances of a conviction for DUID are considerably lessened. Without such chemical tests, the DUID case in court depends almost entirely on the officer's testimony about the driver's behavior. While other evidence, such as driver admissions or evidence of drug possession, is mentioned by some police as helping to strengthen a DUID case, this type of evidence is not always available.

Some police agencies are unable to obtain chemical tests for drugs other than alcohol because of the restrictions of their state's implied consent laws. The implied consent restrictions mentioned by police agencies tend to fall into four categories:

- **Breath test only.** Police agencies in Illinois, Mississippi, and Alaska state that their implied consent law provides for license suspension only for refusal to take a breath test. Hence, the only test that an officer can effectively "require" from a driver is breath. Since there is no currently feasible method of testing for drugs other than alcohol in breath, the police officer is effectively precluded from obtaining a chemical test for those drugs.

- **Driver choice of tests.** Other police agencies report that although their implied consent law allows for the designation of a chemical test other than breath (i.e., blood, urine, or sometimes saliva), the driver may refuse to take a blood test without suffering the sanctions authorized by the implied consent law if he agrees to take another test. In Colorado, Iowa, and West Virginia, if a driver refuses the blood test, the officer must then designate either breath or urine.

  While recognizing that a police officer who selects urine as the other test will still have a specimen that can be

analyzed for drugs other than alcohol, all of these agencies say that breath is almost always designated in these instances. Thus, in these circumstances, a driver can effectively prevent the collection of a specimen that can be tested for drugs. In Michigan drivers may absolutely request a breath test, even if any other type of test is requested by the officer.

- **Limitation to one test.** Police agencies in New Mexico, Indiana, Missouri, and Pennsylvania raised a third problem with their implied consent law in obtaining blood or urine specimens. Their implied consent law permits them to administer only one chemical test. In almost all instances it is department policy to give the breath test because it is most convenient. Even if the breath test indicates that drugs other than alcohol may be involved, they are unable to use the implied consent law to obtain a second test. A spokesman for the Albuquerque, New Mexico Police Department reports that the Albuquerque City Attorney is currently attempting to determine whether the language "test or tests" in the state's implied consent law permits a second test.

- **Specimens available for alcohol analysis only.** Police agencies in three states (California, Michigan, and West Virginia) indicate that they are unable to obtain chemical tests for drugs other than alcohol under their implied consent laws because the statute authorizes chemical testing only for alcohol content. This is an important consideration because, as was discussed in the section on DUID legislation, thirty-eight states do not currently allow implied consent chemical testing for drugs other than alcohol. In these states, police are dependent on the rare driver who agrees to provide a voluntary specimen for drug testing.

Police agencies raised other problems with respect to obtaining body fluid specimens for drug testing. Some police agencies state that it is departmental procedure to obtain breath tests in almost all instances. In several agencies, including the Lincoln, Nebraska Police Department, the policy is to obtain a blood specimen only in the case of a traffic fatality, or if the driver is unconscious. Instead they choose between breath and urine, and the choice is almost always breath, largely because of the messiness associated with collecting urine specimens from impaired drivers. The Kentucky State Police express a similar preference for

breath because of its convenience. The Minnesota State Patrol, sensitive to Amish religious beliefs, will not require blood even though the implied consent law allows them to do so, and instead will require breath or urine.

Ten of the police agencies contacted, including the Birmingham, Alabama Police Department and the Kentucky State Police, report another problem in obtaining blood specimens from drivers arrested for DUID. They indicate that, as described in Chapter 6, doctors or health professionals are often unwilling to draw blood specimens from drivers arrested for DUID for fear of being sued for negligence. As a result, police tend to request breath tests to avoid the trouble of finding doctors who are willing to draw blood specimens.

Inability to Test for Drugs Even If Specimen Is Obtained. Some police agencies contacted state that, even if they obtain a body fluid specimen, the inability to test it for drugs hinders DUID enforcement efforts. Eight agencies contacted report that there are no sufficiently sensitive analytic techniques to detect the presence of drugs other than alcohol. A spokesman for the Alaska State Troopers reports that when they do have blood analyzed for drugs, the results are often inconclusive.

The cost of analysis is also a problem. If a Kentucky State Police officer obtains a blood specimen, he must specify the drugs for which he wants it tested, because the expense of running a drug screen is too high. Officers often do not know what drugs to look for and therefore do not collect the specimens. Both the Utah and Wyoming Highway Patrols report that blood specimens are rarely tested for drugs other than alcohol because each county has to pay for the analysis, and analysis is not considered a necessary expense by county authorities.

The Kansas Highway Patrol reports another obstacle. It is departmental procedure to obtain five cubic centimeters of blood from suspects, but the toxicology laboratory needs more than five cubic centimeters to run a drug screen.

Wisconsin, which revised its implied consent statue in 1977 to include a chemical test for "controlled substances," has taken steps to address some of these problems. To support enforcement of this law, the Wisconsin

Office of Highway Safety Coordination has sponsored two projects with federal funds aimed at implementing analyses of drugs other than alcohol. Conducted at the State Laboratory of Hygiene, the first project examined the feasibility of providing extensive analytical services to law enforcement agencies. Of 401 agencies responding to a questionnaire, 89 percent said that they would use this service if it were readily available. The second project, now underway, will develop the required analytic capability as well as supply expert witnesses needed to testify on drug analyses and to interpret results.

Perception that DUID Cases Will Not Be Prosecuted. Several police agencies point out that DUID arrests are sometimes not made even when the officer could make the arrest, because of the officer's perception that the charge either will not be prosecuted or eventually will be dismissed or reduced. For example, Kansas Highway Patrol officers will not make DUID arrests even if the breath test shows a BAC below .10% w/v, because they believe that DUID charges will not be prosecuted. Police in Columbia, South Carolina, perceive that DUID arrests will be reduced or dismissed later; hence they are reluctant to arrest for DUID.

Lack of Concern About the DUID Problem. All of the previously discussed problems raised by police agencies in enforcing DUID laws have been associated with the lack of enforceability of the laws. Several police agencies also mention that DUID is considered a less serious highway safety problem than DUIL, and that this perception has had some effect on enforcement strategies for the two offenses. The rarity of DUID arrests, in turn, tends to increase the perception that DUID is a relatively unimportant problem. For example, the Nebraska State Police express a lack of concern about DUID because there are so few arrests for it. They compare it to the number of arrests for DUIL and indicate that their activities are clearly directed at DUIL. The Minnesota State Patrol observes that the courts treat DUID, as well as DUIL, as a "medical problem" and are sometimes lax in the adjudication of these charges. This attitude often filters down to the enforcement officers,

who also become lax in enforcing the law. Most of the police agencies contacted, however, do not share these opinions. Many perceived the greatest drug-impaired driving problem to be in cases of polydrug use where alcohol and other drugs are used together.

Hesitancy to Make Arrests Because of Time. A few police agencies report that police officers are often hesitant to make DUID arrests because of the time it takes to process the arrest and to appear in court to testify. This complaint also applies to DUIL. Police departments in Boston, Massachusetts; Wilmington, Delaware; and Albuquerque, New Mexico all raise this issue. The Albuquerque Police Department has a procedure to deal with this general problem. By using "mobile booking units" that go to the scene of the arrest to process the arrestee, the processing time for the arresting officer has dropped from two and one-half hours to twenty minutes. As a result, it is believed that police are more willing to make arrests for DUIL as well as for DUID.

ADJUDICATION OF DUID OFFENSES

The adjudication of persons charged with driving while under the influence of drugs other than alcohol is the process by which a court determines their guilt or innocence. This determination may result from a verdict reached at a trial by a judge or jury. More frequently, however, adjudication occurs when a defendant pleads guilty before trial or agrees to plead guilty to a less serious charge. The latter process, known as "plea bargaining," occurs frequently in criminal law.

To determine the range of current practices used by courts in the adjudication of persons charged with DUID, twenty-one prosecutors in nineteen prosecution agencies that handle DUID cases were contacted. These agencies were selected by determining which of the city police agencies contacted about enforcement reported making arrests for DUID. If the city police agency reported making arrests, then that jurisdiction's prosecution agency was contacted about its adjudication procedures. (Since the city police agencies were selected to reflect a relatively broad

range of geographic locations and populations, the prosecution agencies also reflect that diversity.) The prosecution agencies were informally asked about their procedures for adjudicating DUID charges, the number of DUID charges they typically prosecute in a year, and problems that they encounter in DUID prosecutions.

Practices in DUID Adjudiction

In most instances, the jurisdictions in the study file a DUID charge if the arrest is for DUID or if the facts indicate it. In some instances, however, another charge is filed even if the driver is suspected of DUID. A spokesman for the Los Angeles County District Attorney's Office says that whenever an arrest is made involving both alcohol and other drugs, the alcohol offense is charged because it is easier to prove. The City Prosecutor for Peoria, Illinois, reports a similar procedure.

Even if it is clear that only drugs other than alcohol are involved, some jurisdictions indicate that they are not likely to charge DUID. Prosecution agencies in Lansing, Michigan; Natchez, Mississippi; and Peoria, Illinois, often charge reckless driving instead of DUID because the latter is too difficult to prove. Some prosecutors are more likely to charge DUID if chemical test results for the presence of those drugs are available, making the case stronger. The Orange County District Attorney's Office does not file a DUID charge unless it has chemical test results.

In all of the jurisdictions contacted, if an illicit drug is found in the driver's possession at the time of arrest for DUID, the drug possession charge is also filed; DUID charges may be dropped at this point. Several jurisdictions indicate that since possession is often a more serious charge, the two charges are filed in different courts.

In almost all of the queried jurisdictions the same procedures are used for both DUIL and DUID prosecutions. This is so because the elements necessary to prove both types of cases are the same, except for the cause of impairment. These elements include the operation of the vehicle and impairment of driving capability. As will be discussed later, proving impairment by alcohol is easier than proving impairment by other drugs.

In the City Prosecutor's Office of Phoenix, Arizona, the pretrial procedures for DUID and DUIL cases differ. Phoenix has, since 1974, used a special earned-charge-reduction program for DUIL offenders called the Prosecution Alternative to Court Trial (PACT). Under this program, all persons charged with DUIL who have not participated in PACT before are given the opportunity to plead guilty to a reduced charge if they agree to complete an approved education or treatment program. Persons charged with DUID are not eligible for PACT. A spokesman for the City Prosecutor's Office indicates, however, that about 25 percent of the DUID cases also involve alcohol. In these cases, the charge is filed as DUIL so the driver is eligible for PACT. The other DUID cases are handled by normal prosecution procedures.

Use of Special DUID Prosecutors. In all but one of the prosecution agencies contacted, DUID prosecutions are handled by a member of the general staff. An assistant attorney general in South Carolina says that his agency has had a special program for DUI prosecutions since October 1978, and that there are two special prosecutors on the staff who travel throughout South Carolina for prosecution of DUIL or DUID offenses.

Pretrial Procedures. Pretrial procedures for DUID cases vary among jurisdictions. In most jurisdictions DUID cases are likely to be plea bargained because of the difficulty of proving the case at trial, but jurisdictions vary in the procedures they use in negotiating the plea agreement. Many of the prosecutors say that they are likely to offer to reduce the charge to reckless driving in cases they think would be difficult to prove. At least one jurisdiction, Birmingham, Alabama, is more likely to plea bargain a DUID if there is also a drug possession charge. The only jurisdiction that has actual statistics, the Los Angeles City Prosecutor's Office, reports that in 1978, 238 cases out of 589 DUID charges resulted in pleas to a lesser offense, usually reckless driving. A spokesman for the City Prosecutor's Office theorizes that these charges were reduced primarily because the DUID case was weakened by a lack of chemical test results. Almost all of the jurisdictions contacted are

more likely to reduce a DUID charge than a DUIL charge because of the difficulties involved in prosecuting DUID cases.

Several jurisdictions will not reduce DUID charges under any circumstances. The Orange County District Attorney's Office will not file a DUID case unless the staff thinks that it can be proved; therefore, there is no need to reduce the DUID charge. An assistant attorney general for South Carolina says that his state does not allow plea bargaining in any DUI case. Instead the case either goes to trial or is dismissed.

Even if DUID charges are not plea bargained, in most jurisdictions they rarely go to trial. In many jurisdictions, if no plea agreement is reached, the defendant usually pleads guilty to the DUID charge. In Florida, where DUID and DUIL charges are filed simply as DUI, a person charged with DUID will plead guilty to DUI (which is assumed to involve alcohol), rather than risk having it shown at trial that he was using drugs other than alcohol. On the other hand, a Texas prosecutor indicated if a driver pleads not guilty and requests a trial, his office dismisses the case rather than tries it. Two jurisdictions report that a high percentage of DUID cases goes to trial. In South Carolina almost all cases go to trial. A spokesman for the City Solicitor's Office in Wilmington, Delaware, states that cases that are not plea bargained frequently go to trial. In most jurisdictions (Los Angeles County, Orange County, and Phoenix excepted) there are simply too few cases to generalize about how a prosecution agency will handle a DUID charge. Ten or fewer cases per year are not enough to establish firm procedures for handling any single case. In fact, many prosecutors are hesitant to make any generalizations for this reason. Instead, they observe that each case is evaluated for its strength or weakness, and that any pretrial plea negotiation is based on such a case evaluation. Most prosecutors evaluate DUID cases--especially those unaccompanied by chemical evidence of drug consumption--as "weak"; for that reason they show a greater willingness to make plea agreements with DUID defendants than with DUIL defendants.

DUID Cases at Trial. The types of evidence used to prove DUID charges do not vary a great deal among jurisdictions. Most jurisdictions rely primarily on the police officer's testimony about driving behavior, appearance of the driver, performance of field coordination tests, and, if available, evidence of drugs found in the driver's possession. Very few jurisdictions note the availability of chemical tests for drugs to prove DUID. If a DUID case goes to trial, the chances of the prosecution's winning the case at trial depend largely on the availability of chemical analysis of the driver's blood or urine to prove the presence of a drug. Spokesmen for the prosecution agencies contacted in southern California and Minneapolis, Minnesota, where chemical analyses for drugs other than alcohol are available on a fairly regular basis, agree that the chances at trial depend to a great extent on the availability of such test results. The problem of obtaining chemical test results is discussed more fully in the section detailing problems with DUID prosecutions.

Frequency of Prosecutions for DUID. DUID prosecutions are very rare. For reasons that will be discussed later in this chapter, many prosecutors report that they handle fewer than ten DUID prosecutions per year. Table 7-3 lists estimates of DUID prosecutions per year given by spokesmen for the local or state prosecuting agencies. As can be seen from the table, some jurisdictions are handling fairly large numbers of DUID charges per year. The most notable examples are two very large counties in southern California, Los Angeles and Orange. The combined total of prosecutions by the Los Angeles city attorney and the county district attorney is close to 1,000 per year, while a spokesman for the Orange County District Attorney estimates 300 DUID prosecutions per year. Prosecutors in each of these agencies speculate that at least part of the reason for the very large number of DUID cases per year in southern California is the prevalence of drug use other than alcohol, especially PCP. Still, they indicate that compared to DUIL prosecutions, DUID prosecutions are very few.

A spokesman for the Orange County Prosecutor's Office estimates that compared to approximately 25 DUID prosecutions per month, there might

TABLE 7-3

ESTIMATION OF NUMBER OF DRIVING UNDER THE INFLUENCE OF DRUGS (DUID) PROSECUTIONS IN NINETEEN JURISDICTIONS

PROSECUTING AGENCY	ESTIMATED NUMBER OF DUID PROSECUTIONS
Jefferson County District Attorney Birmingham, Alabama	7-10 last three years
City Prosecutor's Office Phoenix, Arizona	100-200/year
City Attorney's Office Los Angeles, California	589 in 1978 (actual data)
District Attorney's Office Los Angeles, California	300/year
District Attorney's Office Orange County, California	300/year
Larimer County District Attorney Fort Collins, Colorado	10/year
City Solicitor's Office Wilmington, Delaware	3 last four years
State's Attorney's Office Tampa, Florida	No estimate--extremely rare
Corporation Counsel Peoria, Illinois	2-3/year
Marion County Prosecutor's Office Indianapolis, Indiana	10/year
Anne Arundel County Prosecutor's Office Anne Arundel County, Maryland	No estimate--extremely rare

TABLE 7-3

ESTIMATION OF NUMBER OF DRIVING UNDER THE INFLUENCE OF DRUGS (DUID) PROSECUTIONS IN NINETEEN JURISDICTIONS (Continued)

PROSECUTING AGENCY	ESTIMATED NUMBER OF DUID PROSECUTIONS
Ingham County Prosecutor's Office Lansing, Michigan	6/year
Minneapolis City Attorney's Office Minneapolis, Minnesota	20-50/year
City Prosecutor Natchez, Mississippi	None in last two years
City Attorney's Office Lincoln, Nebraska	3-6/year
City Prosecutor Albuquerque, New Mexico	7-8/year
Assistant Attorney General State of South Carolina	5-8/year
Dallas City Attorney's Office Dallas, Texas	250/year
Kanawha County Prosecutor's Office Charleston, West Virginia	5-6 in last three years

be 50 to 100 DUIL prosecutions per day. Similarly, a spokesman for the City Prosecutor's Office in Phoenix, Arizona compares the estimated 100 to 200 DUID prosecutions per year to the 6,000 to 8,000 DUIL prosecutions per year. The difference is even greater in communities that report a smaller number of DUID prosecutions. The Larimer County (Colorado) Prosecutor's Office estimates that it handles 10 drug-impaired driving prosecutions per year, as opposed to 5,000 per year for alcohol-impaired driving. Similarly, the City Prosecutor for Albuquerque, New Mexico, estimates that the 7 to 8 DUID prosecutions per year compare to 4,500 DUIL prosecutions. Clearly then, even in jurisictions reporting relatively large numbers of DUID prosecutions, the number is very small compared to alcohol-impaired driving prosecutions.

Problems in Adjudicating DUID Cases

A major impediment to the enforcement of DUID laws is the difficulty in proving the case at trial, as has been mentioned in reference to the prosecution's decision even to take the case to trial. This section focuses on the problems involved in prosecuting DUID, many of which stem from problems with DUID laws and enforcement practices described above.

Lack of Sufficient Evidence. The primary problem cited by most jurisdictions in proving DUID cases is the absence of chemical test results to introduce as evidence. Only a few jurisdictions have such toxicology results available in a DUID prosecution. There were several reasons given why toxicology results were never available.

Many of the prosecutors noted that the restrictions imposed by the implied consent law on collecting and analyzing a blood specimen for drugs other than alcohol posed a problem in DUID adjudication. (These restrictions were discussed in Chapter Six.) All agreed that the only sure way to obtain a body fluid specimen for drug analysis in such states was to persuade the driver to give the specimen voluntarily. Several prosecutors said that in a few instances their police did obtain blood specimens voluntarily, but that this was very rare. A number of prosecutors maintained that even though their state's implied consent law

did not authorize police officers to collect blood specimens for drug analysis, officers nonetheless had authority, under their general powers to search for evidence of crime, to draw specimens. They noted, however, that this was just an argument and that no case had ever arisen challenging the collection of a blood or urine specimen for drug analysis not authorized by the state's implied consent law.

The police in the city of Los Angeles use an interesting procedure for dealing with California's implied consent law, which presently does not allow testing for drugs other than alcohol. If the police suspect that the driver is using drugs other than alcohol, they administer what the city prosecutor calls an "admonishment." In the admonishment the police officer informs the driver that he would like a blood or urine specimen, that it cannot be obtained by the implied consent law, but that if the driver does not give the specimen, his refusal may be commented on in court. Comment on refusal is widely regarded as constitutional by state courts; moreover, the UVC and a number of state implied-consent statutes--including those of Alabama, Delaware, and Iowa—specifically authorize comment at trial when a driver refuses the test. The spokesman for the Los Angeles City Prosecutor's Office indicates that some local judges allow the prosecutor to comment on such a refusal in court. Typically such an admonishment will be given when an officer obtains a .00% w/v reading on the breath test and wants a blood or urine specimen to test for drugs. Presently about 50 percent of the DUID cases filed by the Los Angeles City Prosecutor are supported by a chemical test for drugs. Another procedure that Los Angeles has recently instituted to strengthen DUID cases is to take the driver to a hospital to obtain a physician's report on whether he is under the influence of drugs other than alcohol.

For those jurisdictions where blood or urine specimens are obtained for drug analysis, another difficulty exists in obtaining those specimens. Simply put, prosecutors perceive that police are either not aware of the availability or are unwilling to go to the trouble of obtaining a test other than breath that can show the presence of drugs. Even the Los Angeles City Prosecutor's Office, which has actively sought police assistance in

obtaining blood and urine specimens in DUID cases, indicates it is still getting them in about only 50 percent of the cases. They do report, however, that as time passes the practice is becoming more and more regular.

Other evidence besides chemical tests for drugs is mentioned as being important to the proof of DUID cases, yet is not often available. Several jurisdictions indicate that an admission by the driver that he was using drugs is very effective in proving DUID cases. Admissions, however, are rarely obtained. The Anne Arundel County (Maryland) Prosecutor's Office reports that admissions of drug use come primarily in the case of prescription drugs, when the driver explains to the police officer that he is currently taking drugs, not realizing that driving under the influence of the drugs, if they impair performance, is unlawful. In addition to admissions, possession of a drug by the driver sometimes helps to strengthen a DUID case. Most of the prosecutors stress, however, that it is difficult to generalize about the strengths and weaknesses of DUID cases because of the small number of cases with which they have dealt.

Unavailability of Adequate Chemical Tests for Drugs. In jurisdictions where blood or urine specimens are not available for drug analysis, prosecution agencies, like police agencies discussed earlier, believe that there are no effective procedures for determining drug content.

Like some police agencies, the Los Angeles County District Attorney's Office and Minneapolis City Attorney's Office voiced the opinion that one almost had to know the drug one was looking for to find it in a driver's blood or urine. Prosecutors also explained that the expense in obtaining and analyzing blood or urine for the presence of drugs is not justifiable for a charge of driving under the influence of drugs. DUID is almost always a misdemeanor traffic violation that does not carry a high judicial priority. It is difficult for prosecutors to justify the expense of costly drug analyses as well as the testimony of laboratory technicians or toxicologists if a trial is held using the chemical test results. This is an important factor to consider in understanding not only why blood or urine

specimens are not often obtained, but also why many DUID cases are processed through plea agreements. Prosecutors often believe it is simply not worth the expense to become involved in time-consuming trials over minor offenses.

Another problem associated with chemical tests, cited by a spokesman for the Orange County District Attorney's Office, is the cost and difficulty of obtaining **quantitative** data on drugs present in body fluid specimens. Qualitative tests can indicate that a driver has used one or more drugs other than alcohol, but they do not provide evidence that the drugs in any way contributed to driver impairment.

Standards to Relate Drug Presence to Driver Impairment. A final problem in prosecutions for DUID mentioned by some jurisdictions is the lack of standards for relating the presence of a drug in the driver's blood or urine to driver impairment. Not all jurisdictions recognized this as a problem. Generally, only those jurisdictions that have had experience with chemical test results on a fairly regular basis mentioned the difficulty in proving driver impairment merely by establishing the presence of a drug. These jurisdictions express a desire to establish judicially accepted levels of drug content that raise presumptions of impairment, as is presently done for alcohol. Several prosecution agencies say that the only existing way to attempt to prove drug impairment is to have expert witnesses testify to the effect of the particular drug on driving ability. According to prosecutors, not only is this procedure unjustifiably expensive for a DUID prosecution, but, it is also difficult to find qualified experts to testify.

SANCTIONING OF DUID VIOLATORS

Sanctions for DUID are imposed after the driver has been found guilty of or has pled guilty to the DUID charge, or after the driver has pled guilty to an offense other than DUID as the result of plea bargaining. Some jurisdictions also use a variation of plea bargaining called "earned charge reduction," under which a driver charged with DUID agrees to be sanctioned before adjudication of the DUID charge in return for the

prosecutor's promise to reduce the charge after the driver fulfills the sanctions imposed.

Three types of sanctions may be imposed. First, a jail term, fine, or driver's license suspension are **punitive** sanctions that the court may impose on a driver for conviction of DUID. Second, a court could impose nonpunitive **"health/legal"** sanctions. Health/legal sanctions require that a defendant participate in an education or treatment program. They are often imposed as conditions of probation or a suspended sentence, but may also be imposed as a condition of an earned-charge-reduction program. The third alternative is **administrative** sanctions. In some states, the authority to take action on a driver's license following conviction of DUID rests not with the court but with the state department of motor vehicles (DMV). Action taken by the DMV against a driver convicted of DUID is often referred to as "administrative" action. The DMV in these states may suspend or revoke the driver's license for conviction of DUID, and some states, such as Maine, even require that the driver participate in education or treatment to get his license back. In many states, DMVs also have general authority to take action on a driver's license if they learn that the driver is abusing drugs. This action is taken as part of the DMV's medical review procedures and is independent of any conviction for DUID.

The discussion that follows describes current practices used by courts and DMVs in imposing sanctions on drivers convicted of DUID and also describes the nature of those sanctions. Both punitive and nonpunitive sanctions are treated. Information on court-imposed sanctions was obtained through contacts with nineteen prosecution agencies. Information on administrative sanctions imposed by DMVs was obtained through contacts with a judgmental sample of thirteen DMVs. Finally, 195 education and treatment agencies were contacted to identify drug and driving programs conducted for court-referred or DMV-referred drivers. Thirteen of these education and treatment agencies report that they operate such programs.

Sanctioning Practices

Punitive Sanctions. As with the adjudication of DUID charges, it is difficult to generalize about the punitive sanctions that a court will impose on drug-impaired drivers, simply because there are so few cases. Most of the departments contacted reported that persons convicted of or pleading guilty to DUID receive sanctions similar to those imposed on a person convicted of DUIL. Courts typically impose a fine, and sometimes jail time. In several jurisdictions, including Albuquerque, New Mexico; Orange County, California; and Tampa, Florida, courts are more likely to impose severe sentences (i.e., jail time) on persons convicted of DUID. A spokesman for the Los Angeles City Attorney's Office attributes this to the fact that persons convicted of DUID are more likely to have bad previous records, particularly in DUID cases involving illegal drugs.

Health/Legal Sanctions.

Procedures for Requiring Health/Legal Sanctions. In many jurisdictions treatment or education procedures imposed for DUID resemble those used for DUIL. Most of the prosecutors state that any treatment or education requirement is usually handled as a condition of probation or suspended sentence. Several jurisdictions, such as Wilmington, Delaware, and Birmingham, Alabama, indicate that their earned-charge-reduction program serves both DUIL and DUID offenders.

In some jurisdictions persons convicted of DUID are less likely to receive education or treatment. Several prosecutors state that the imposition of education or treatment for DUID convictees is essentially up to the judge and is less systematic than for alcohol. Some jurisdictions also say that judges tend to be more harsh with persons convicted of DUID than of DUIL.

Health/Legal Education and Treatment Programs. Education programs are designed to provide information about drug abuse to persons who are not necessarily drug abusers. Treatment programs are directed primarily at persons diagnosed as drug abusers, and rehabilitation is their primary

goal. A component on drugs and driving in these programs makes them useful to a court for referring drivers convicted of DUID. The topic of drugs and driving can appear in two settings: first, education and treatment programs directed at drug abuse in general may include traffic safety as a topic; and second, traffic safety programs directed primarily at alcohol may include material on other drugs.

The programs offered by almost all of the state and local agencies contacted do not include a specific component on drugs and highway safety. Spokesmen for most drug education and treatment programs report that the subject of drugs and driving is probably discussed in their programs, but there is no identifiable part of the program directed at the topic. Similarly, in most traffic safety programs, programs directed at alcohol and highway safety often include a discussion of other drugs, but as a very minor part of the program and not as a specific component. No agency contacted has a program aimed directly at the driver impaired by drugs other than alcohol.

Only thirteen of the 195 agencies contacted have education programs with a specific part directed at drugs and driving. Seven agencies have treatment programs with a component directed at drugs and driving. All of the agencies report that most of their clients are referred by the courts or DMVs.

Education Programs. Table 7-4 lists thirteen education programs identified in study. As the table indicates, varied agencies are responsible for the programs, including state departments of public safety, health, substance abuse, and mental health, as well as local agencies. All of the programs are either drug abuse education programs or alcohol and driving programs, and most locate the classes throughout the state.

Almost all of the education classes include lectures that present information about drugs and driving. Group discussion is encouraged in most. The Bureau of Substance Abuse in Boise, Idaho uses role playing in its education program. The course, called the Chemical Awareness Seminar Training, is divided into two parts. The first part provides factual information on drugs, alcohol, and the hazards of each. The

second part is the "Personal Growth" component that uses a series of real-life situations involving alcohol and drugs, in which the students play roles. The purpose of the exercise is to improve the student's ability to make a reasonable decision with respect to alcohol and other drugs.

The primary objective of the classes in most agencies is to increase the students' perception of the health and safety hazards of alcohol or drug use. The danger of being arrested for driving under the influence of alcohol or other drugs is also stressed in most programs. Table 7-5 details the responses of the thirteen agencies concerning the nature of the drug and driving component of their education classes. Seven of the thirteen agencies contacted were able to estimate the component of the education program directed at drugs and driving. With the exception of the two Idaho programs, the estimates of most agencies were 20 percent or less. Note that many of the agencies contacted that could not identify a drug and driving component in their drug education programs; those that did estimated that drugs and driving were probably an included topic less than 5 percent of the time.

As noted above, all of the thirteen agencies indicate that most or all of their referrals come from courts. One jurisdiction also receives referrals from the state driver-licensing agency. Table 7-6 presents summary information about the court referral procedures including the point in the adjudication process at which offenders are referred, the type of offender referred, and the type of charge.

Table 7-7 presents the responses of the thirteen agencies regarding how their programs are funded. All but two of the agencies receive external funding from federal, state, or local sources. The table shows the frequency of responses with respect to particular external funding sources. All of the agencies assess fees to clients.

Treatment Programs. Table 7-8 presents general characteristics of the seven treatment programs that have curricula directed at drugs and driving. All but one (the Virginia ASAP program) are primarily drug treatment programs, which include information on drugs and driving. Most of the seven treatment programs are coordinated by either the state

TABLE 7-5

CHARACTERISTICS OF DRUG AND DRIVING EDUCATION PROGRAMS CONDUCTED IN THIRTEEN SELECTED JURISDICTIONS

CHARACTERISTIC					
FORMAT *	STATED OBJECTIVES *	TYPE OF INFORMATION PRESENTED *	PERCENTAGE OF CLASS REFERRED AS A RESULT OF DRUG IMPAIRED DRIVING (APPROXIMATE[1]) **	NUMBER OF CLASSES[2] **	NUMBER OF STUDENTS PER CLASS[3] **
Lecture (12)	Increased Perceived Health Threat (11)	Information about Drug Effects on Driving (10)	45% (2)	52 (1)	30 (1)
Group Discussion or Activity (9)	Increased Perceived Safety Threat (11)	Information about Drug Effects on the Body (7)	20% (1)	20 (1)	20 (1)
Films (6)	Increased Perceived Enforcement Threat (9)	Information about Drug Laws (6)	10% (2)	10 (1)	16 (1)
Family Therapy (2)	Motivate to Seek Treatment (6)		5% (1)	7 (1)	15 (1)
Role-Playing (2)			>5% (1)	6 (3) 5 (1)	14 (1) 5 (1)

* The number of programs reporting each characteristic appears in parentheses following that characteristic.

** The number of jurisdictions reporting each characteristic appears in parentheses following that characteristic.

[1] Information not available from six jurisdictions.

[2] Information not available from five jurisdictions.

[3] Information not available from seven jurisdictions.

TABLE 7-6

COMPARISON OF COURT REFERRAL EDUCATION PROGRAMS FOR DRUG-IMPAIRED DRIVERS

TYPE OF OFFENDER	NUMBER OF JURISDICTIONS REPORTING	TYPE OF CHARGE	NUMBER OF PROGRAMS REPORTING	WHEN REFERRED	NUMBER OF PROGRAMS REPORTING
Multiple Offenders only	8	Driving While Under Influence of Alcohol	11	Postconviction	12
All Offenders	4	Driving While Under Influence of Drugs	11	Preconviction	2
First Offenders Only	1	Other Drug Related Charges	5		

TABLE 7-7

FUNDING OF DRUG ABUSE EDUCATION PROGRAMS

FUNDING	NUMBER OF PROGRAMS REPORTING
SOURCE OF EXTERNAL FUNDING	
U.S. Department of Transportation [Section 402 Funds]	5
U.S. Department of Health, Education, and Welfare	3
National Institute on Drug Abuse	2
National Institute on Alcoholism and Alcohol Abuse	2
State Governments	2
Local Sources	1
METHOD OF ASSESSING CLIENT FEES *	
Sliding Scale Based on Client's Ability to Pay	8
Flat Fee	5

* Client fees ranged from $0 to $425.

TABLE 7-8

COMPARISON OF PROGRAMS HAVING TREATMENT COMPONENTS FOR DRUG-IMPAIRED DRIVING

SPONSORING JURISDICTION	CHARACTERISTIC		
	REGION	TYPE OF PROGRAM	NUMBER OF PROGRAMS IN STATE
Hawaii	West	Drug Treatment Program	12
Iowa	Midwest	Drug Treatment Program	Statewide
Indiana	Midwest	Alcohol/Driving Program	11
Kentucky	South	Drug Treatment Program	16
Louisville Kentucky	South	Drug Treatment Program	1
Oregon	West	Drug Treatment Program	20
Virginia	South	Alcohol/Driving Program	Statewide

mental health or substance abuse department.

All of the treatment programs provide outpatient treatment services, all offer group therapy, and all but one make available outpatient individual therapy. Only one of the agencies, the Mental Health Division of the Hawaii Department of Health, provides inpatient therapy with a specific drug and driving component. The primary objective of each program is to treat the drug problems of the individual client. In addition, a small number of agencies also attempt to increase the client's understanding of the threat of drugs and driving to his health and safety. Table 7-9 presents the responses of the agencies concerning the characteristics of drug and driving treatment components in their communities.

The majority of the agencies were unable to provide estimates of the percentage of the treatment program directed at drugs and driving. In those that did, it was usually 10 percent or less, although a drug treatment program sponsored by the Mental Health Division of the Oregon Department of Human Resources directs 90 percent of the program at drugs and driving. As was mentioned regarding drug education classes, it is impossible to draw any conclusions about the degree to which drug treatment programs throughout the country address the subject of drugs and driving from this set of data. Many of the agencies whose drug treatment programs do not include a drug and driving component nevertheless report that the relationship of drugs to highway safety is almost certainly discussed in their treatment programs.

All of the seven agencies with a drug and driving component in their treatment programs receive at least some of their clients as a result of court referrals. Table 7-10 presents summary information about the court procedures, including information about the manner of referral, the type of offenders referred, and the type of criminal charge involved.

All of the agencies receive part or all of their financial support for treatment programs from federal, state, or local funding. All but one of the agencies charge fees to clients as well. Table 7-11 presents the frequency of the seven agencies' responses concerning the sources of external funding, the range of client fees charged, and the manner of

TABLE 7-9

CHARACTERISTICS OF DRUG AND DRIVING TREATMENT PROGRAMS IN SEVEN SELECTED JURISDICTIONS

FORMAT	NUMBER OF PROGRAMS REPORTING	STATED OBJECTIVES	NUMBER OF PROGRAMS REPORTING	PERCENTAGE OF PROGRAMS DIRECTED AT DRUGS AND DRIVING	NUMBER OF JURISDICTIONS REPORTING *
Outpatient [individual]	6	Treat Individual Drug Problem	7	90	1
Outpatient [group]	7	Increased Perceived Health Threat	2	10	1
Inpatient [individual]	1	Increased Perceived Safety Threat	2	5	1
Inpatient [group]	1	Increased Perceived Enforcement Threat	2		

* Information not available from four jurisdictions.

TABLE 7-10

COMPARISON OF COURT REFERRAL TREATMENT PROGRAMS FOR DRUG-IMPAIRED DRIVERS

TYPE OF OFFENDER	NUMBER OF JURISDICTIONS REPORTING	TYPE OF CHARGE	NUMBER OF PROGRAMS REPORTING	MANNER OF REFERRAL	NUMBER OF JURISDICTIONS REPORTING
Multiple Offenders Only	6	Other Drug-Related Offenses	7	Postconviction	6
All Offenders	1	Driving while under the Influence of Drugs	5	Preconviction	1
First Offenders Only	0	Driving while under the Influence of Alcohol	4		

TABLE 7-11

FUNDING OF DRUG ABUSE TREATMENT PROGRAMS

FUNDING	NUMBER OF PROGRAMS REPORTING
SOURCE OF EXTERNAL FUNDING	
State Governments	3
U.S. Department of Transportation [Section 402 Funds]	3
Law Enforcement Assistance Administration	1
National Institute on Drug Abuse	1
National Institute on Alcoholism and Alcohol Abuse	1
METHOD OF ASSESSING CLIENT FEES *	
Sliding Scale Based on Client's Ability to Pay	4
Flat Fee	1
Third-Party Arrangements	1

* Client fees ranged from $25 to $300.

payment of client fees.

Administrative Sanctions. Thirteen state driver-licensing agencies (DMVs) were questioned about their procedures for taking action on the license of a person identified as a drug-impaired driver. Most DMVs have two procedures. The first is usually mandatory license action taken against a driver for conviction of a single DUID offense or action taken as a result of a number of DUID convictions within a specified period of time. The second procedure involves discretionary action by the DMV when it comes to its attention from any of a variety of sources that a driver may be operating a vehicle while impaired by drugs.

Sanctions Imposed for DUID Conviction(s). No DMVs contacted keep separate totals of DUID and DUIL convictions reported to them by the courts. As a result, no DMV contacted could supply yearly totals of DUID cases. All of the DMV personnel with whom we spoke indicate, however, that the number of DUID convictions compared to total DUI convictions is **extremely** small. This is certainly consistent with the reported activity in the area of DUID by the courts.

Some of the DMVs contacted indicate that suspensions or revocations for DUID convictions are determined by the courts. In these instances the DMV carries out the court's order by suspending or revoking the driver's license for the court-ordered period of time.

In other jurisdictions, the DMV has the authority to suspend or revoke a driver's license for DUID when it receives notice of the conviction from the court. In all of the jurisdictions that follow this procedure, the DMV takes the same steps for DUIL and DUID convictions. The typical suspension or revocation is up to one year for conviction of first-offense DUID and from three to five years for conviction of second- or subsequent-offense DUID.

Most DMVs contacted report that the court is the agency that requires persons convicted of DUID to attend treatment or education programs. In those states (such as Maine) where the DMV is involved in requiring education and treatment, the treatment requirements for DUID are

essentially the same as those for DUIL.

Sanctions Imposed through Medical Review Procedures. In addition to action taken for conviction of DUID, a substantial number of DMVs are authorized to take action on a driver's license when it comes to their attention that the driver is medically unfit to drive. Most states having such a provision include chronic or habitual drug abuse as one criterion for being "medically unfit." Such action is usually taken by a division of the DMV typically called a "medical review board."

The procedure used by the medical review board is best illustrated by California's procedures. Drivers are identified for medical review by a variety of disabling physical and mental conditions. These include epilepsy, diabetes, heart and brain disease, and physical impairments associated with aging, as well as alcoholism and drug abuse. Reports come to the DMV from such sources as doctors, police, courts, relatives and friends, and self-reporting drivers. Once the DMV receives such information, a preliminary evaluation is made. At that time, the DMV may take no action, require a hearing or an interview, or take action immediately upon the driver's license. Actions that the DMV, through its medical review board, can take include: issuing a probationary license; suspension; revocation; and refusal to license. The DMV may require periodic reports from doctors, probation officers, or other agencies to determine when a person is no longer a hazard as a driver.

Most of the medical review cases are associated with physical impairments and lapses of consciousness (primarily epilepsy). Of the cases considered by the California DMV in a brief period between March 1 and March 9, 1979, officials estimated that less than 10 percent were drug-related. The typical action on a drug-related case includes suspension, revocation, or issuing a probationary license. The DMV often requires periodic reports of the driver's abstinence from drugs from doctors, probation officers, or authorized clinics. There is a special probationary status for drivers participating in a methadone maintenance program. The decision to restore an unrestricted license is based upon the DMV's determination that the driver is no longer an habitual user of

illicit drugs. (A more complete explanation of California's procedures for dealing with medically impaired drivers is contained in Janke, Peck, and Dreyer [1978].)

Sanctioning Problems

Each type of sanction used for persons convicted of DUID has problems associated with it. As mentioned in the section on sanctioning practices, **punitive** sanctions for DUID are imposed much the same as for DUIL. In fact, most statutes prohibiting DUID and DUIL make no differentiation in the range of punishments for each. As a result, sanctions for DUID are thought of in the same light as those for DUIL.

The effectiveness of present sanctions in reducing recividism by drivers who are convicted, or in deterring other drivers from committing drug-impaired driving offenses, is not known. If drug-impaired driving is established as a significant highway safety problem, it is important to evaluate the effectiveness of present sanctions before any large-scale countermeasure programs relying on existing sanctions are implemented.

Health/legal sanctions have a more readily identifiable problem associated with them. Almost all courts have adequate procedures to require a person to seek education or treatment. However, education or treatment programs to which convicted drug-impaired drivers can be referred seldom address drugs and driving safety. Less than ten percent of the education and treatment agencies contacted have specific components on drugs and driving. Without such programs, courts can make referrals to deal with a basic drug problem but cannot address the very problem that got the driver into court in the first place—driving under the influence of drugs.

Administrative sanctions with respect to DUID convictions have the same problems as traditional sanctions. The range of sanctions for DUID is the same as for DUIL, with no conclusive proof that the two should be treated similarly. Medical review procedures can be personalized to meet individual needs, but they suffer from the same problems as health/legal sanctions—lack of education or treatment programs specifically addressing the topic of drugs and driving.

SUMMARY

Application of DUID laws parallels that of DUIL laws although a much lower priority is placed on DUID. Police training for DUID enforcement is usually an adjunct to DUIL training. The decision to stop a driver for DUID is based on the same observations as for DUIL. Once a driver is stopped, the decision to arrest for DUID is usually based on the driver's possession of drugs, visible impairment with no odor of alcohol, and admissions of drug use made by the driver. In states that allow them, preliminary breath tests are sometimes used in the decision to arrest for DUID. After an arrest for DUIL has been made, police will sometimes amend the charge to DUID when breath tests indicate that the driver had not been drinking.

Police agencies report problems in making DUID arrests that are not present in DUIL arrests. Unlike alcohol, there are no simple and reliable chemical tests that can be used by police officers, either in the field or at the station, to support their investigation of DUID. Even if police officers suspect the use of drugs other than alcohol, many reported that state laws or departmental arrest procedures prevent them from obtaining a body fluid specimen that can be analyzed for those drugs. In the relatively infrequent case when a test is obtained for drugs other than alcohol, blood tests are almost always given. Some agencies report that even if a blood sample is obtained, the lack of analytic techniques or the cost of such methods limits analysis for drugs.

Arrests for DUID are comparatively rare. Arrest statistics indicate that about one DUID arrest is made for every one hundred DUIL arrests. DUID charges are frequently plea bargained to other offenses, primarily reckless or careless driving. If a DUID case goes to trial, most prosecutors indicated that the chances of obtaining a conviction were poor.

The primary obstacle to obtaining DUID convictions that prosecutors mentioned was proving the case at trial. Unlike DUIL cases, the only evidence usually available is the arresting officer's testimony about the driver's appearance and behavior. Most prosecutors indicated that they rarely had chemical tests for drugs to use as evidence. Agencies that

report the availability of drug tests agree with police sentiments about the cost and effectiveness of drug tests. A final obstacle cited by prosecutors was the difficulty in proving that the presence of a drug found in a driver's blood was the cause of his driving impairment.

It is difficult to generalize about the sanctions that will be imposed on a drug-impaired driver simply because there are so few cases. Traditional court-imposed sanctions such as fine or jail are likely to be the same as or more severe than those imposed on alcohol-impaired drivers.

Many jurisdictions indicated that referrals to education or treatment programs would be made for drug-impaired drivers in much the same way as for alcohol-impaired drivers. The typical programs to which drug-impaired drivers are referred are either drug abuse programs that briefly touch upon drugs and driving or alcohol and driving programs that include material on drugs and driving. Both types of programs typically devote only a small amount of time (less than 5%) to the topic of drugs and driving.

Drug-impaired drivers may also be sanctioned by having administrative action taken on their driver's license. Depending on the state, either the court or the state department of motor vehicles (DMV) may restrict, suspend, or revoke the licenses of drivers convicted of DUID. The DMV may also take licensing action against drug-impaired drivers through medical review boards. Through this procedure, drivers with drug problems who come to the attention of the medical review board are evaluated; retaining driving privileges is often conditioned upon obtaining drug treatment or abstaining from drugs.

CHAPTER EIGHT
INFORMATION AND EDUCATION COUNTERMEASURES

INTRODUCTION

Education and information countermeasures comprise a second major category of action against drug-impaired driving. These countermeasures provide information to audiences formally in classroom settings or more informally through various dissemination channels (e.g., television, newspapers). In general, such information deals with the effects of drugs on driving performance and the possible highway safety implications of driving after using drugs.

The discussion in this chapter treats both the formal classroom-oriented mechanisms of information transfer (called here "education" countermeasures) and the more informal mechanisms (called "public information and education" or PI&E countermeasures). First, a brief background section defines various subcategories of countermeasures. This is followed by a discussion of current and recent education and information programs.

The discussion is based on information obtained through contacts with federal, state, and local organizations that support or operate information and education programs.

The approach used was as follows. First, federal and state agencies with responsibility in the areas of public health and safety, traffic safety, and education were contacted. Referrals to local agencies or individuals in charge of specific programs were obtained if any activity was identified. Then, referrals were followed up. By this approach, it is believed that any major program dealing with drugs and driving would have been identified. In all, about 200 contacts with federal, state, and local agencies believed to be responsible for activities in this area were made.

BACKGROUND

Education countermeasures for the drug and driving problem tend to fall into the following five categories:

- driver education,
- general health education,
- drug abuse/substance abuse education,
- professional medical education, and
- professional education for highway safety specialists.

Driver education courses present information on driving techniques and rules of the road to both special and general audiences. The archetypal driving education course is that given to high school students who are learning to drive. Many of these courses now include material on alcohol impairment of driving skills, but the topic of drugs and driving is seldom addressed.

General health education includes courses given to school children on hygiene and health and to more restricted groups, for example, members of senior citizens organizations, expectant mothers, and participants in health maintenance organizations (HMOs). There is no evidence in the literature that any of these courses give any significant attention to the drug and driving problem.

Education programs on **drug abuse and substance abuse** have been conducted in a number of jurisdictions. Globetti (1975) reviewed and assessed such programs and concluded that they were generally ineffective in stopping illegal use of drugs. He found the materials used in many programs were inaccurate and not credible to students. He recommended that more emphasis be placed on the social context of drug use and the reasons for using drugs.

Several authors have recommended special education programs on drugs and driving for **health professionals.** For example, Milner (1972) and Whitehead and Ferrence (1976) have suggested changes in physicians' prescribing habits through education, and Ashworth (1975) and Silverstone (1974) recommend that physicians be educated to warn patients about the effects of drugs on driving. Again, there is no evidence that any of these recommendations have been widely adopted.

The last category of education programs, **professional education for highway safety specialists,** includes university courses for degree credit, special seminars, and other special activities for persons who are studying for highway safety careers or who are already active in the field (e.g., driver education instructors, police officers, prosecutors, judges, governors' representatives for highway safety). Many of the curricula included in these courses deal with alcohol and highway safety, but few treat the subject of drugs and driving except in a very cursory manner (Institute for Research in Public Safety 1972; Nesbitt, McGill, and Lipecky 1976).

Public Information and Education (PI&E) countermeasures (often called "campaigns") have been used worldwide to promote highway safety (Wilde 1971). In recent years many of these campaigns have dealt explicitly with the subject of alcohol and highway (Ross 1973; Swinehart and Grimm 1972; Worden, Waller, and Riley 1975). However, the subject of drugs and driving has seldom been addressed in these campaigns, except in rare instances as related to the combined effects of alcohol and other drugs.

Although occasional calls for PI&E programs on drugs and driving are found (e.g., Roper 1976), the literature indicates there has been little activity in the past to educate and inform people about the effects of drugs on driving and about the extent to which driving after using drugs constitutes a highway safety problem. This should not be surprising since there is little knowledge readily available for use in countermeasures of this type.

FINDINGS FROM CONTACTS WITH OPERATIONAL AGENCIES

A total of 195 telephone contacts were made with federal, state, and local agencies that might have education and information programs dealing with drugs and driving. Twenty-one of these contacts were at the federal level. Each agency was asked to describe the nature of the drug and driving components of their programs, if any.

Our objective in these contacts was to determine what programs were known to operational personnel. Materials that could be found only by scholars using sophisticated information retrieval methods were not sought. Thus, the findings should not be interpreted to represent what exists in

this area, but rather, to indicate what is typically being used by program personnel.

An additional caution is warranted. Public information and education campaigns and materials are seldom placed in the archival literature. PI&E documents are often not placed in libraries or indexed in traditional sources. Finding documentation on these types of programs is often a matter of chance and depends greatly on the memory of individuals who participated. Thus, we believe that more is being done than has been identified. We do not believe, however, that programs not identified differ greatly from those reported.

State and Local Programs

Education Programs. Of the sixteen state and local agencies that indicated they had a specific drug and driving component, only three were education programs conducted apart from court referral programs (see Chapter Seven for a discussion of court referral programs for drugs and driving). The three agencies are:

- Oakland County, Michigan, Office of Substance Abuse;
- University of Alaska Center for Alcohol and Drug Addiction Studies; and
- The American Association for Retired Persons (AARP).

All of the programs described were in the driver education category. Oakland County's program is for teachers of driver education programs. The program is designed to show how to present information on substance abuse and driving to high school students. Most of the emphasis is on alcohol, but drugs other than alcohol are also covered. The Alaska program is just getting started and will incorporate a three- to four-day unit on drugs and driving into its six-week driver education course for high school students. Plans are to expand the present effort in Fairbanks to cover the entire state. The AARP reported a new program called "55 Alive-Mature Driving," described as a six-week driving safety program

directed at persons over the age of fifty-five. The program is currently being conducted in four states, and devotes about ten percent of its classroom time to the problems of driving after taking prescription drugs.

Public Information and Education Programs. Five of the state and local agencies contacted said they had or formerly had PI&E programs dealing directly with drugs and driving. In 1976, the Virginia Pharmaceutical Association sponsored a comprehensive public information program directed at drugs and driving. Aimed primarily at polydrug use, the goals of the program were to educate health professionals to the effects of drug/alcohol interactions on driving performance and to inform the public of the hazards of using drugs in combination with alcohol while driving. A survey was conducted to determine the extent to which health professionals were given instructions concerning the effects of drugs and alcohol and then a series of seminars was conducted on a regional basis throughout the state to review with health professionals the effects of drug/alcohol interactions. Following this, a "public awareness" campaign was conducted for approximately four to six weeks during which published literature, radio and television spots, and speakers' bureaus were used to inform the public of the dangers of driving after taking drugs and alcohol.

In following up a study of drug use and driving in South Carolina (Jaeger, Fleming, and Appenzeller 1975), the South Carolina Commission on Alcohol and Drug Abuse in cooperation with the South Carolina Pharmaceutical Association initiated a public information campaign dealing with drugs other than alcohol. The campaign, conducted under the auspices of the South Carolina Alcohol Safety Action Program as a special project of the Commission, emphasized the hazards of driving after using over-the-counter, illicit, and prescription drugs. Among the components of this program were:

- leaflets distributed by the state's pharmacies warning customers of the dangers of driving after taking drugs;
- billboards, radio and TV spots, posters, and bumper stickers using the network of ASAP coordinators in each county; and

- newspaper articles explaining the campaign.

In addition, the South Carolina Commission on Alcohol and Drug Abuse recently produced a film entitled "Why Me?", illustrating the hazards of combining alcohol with other drugs based on closed course driving tests.

The Minnesota State Pharmaceutical Association, since 1979, has been distributing materials to state pharmacists containing information that should be given to persons using prescribed medications. The packets stress the need for pharmacists to inform persons of the hazards of drug use and include handouts about each class of drugs that are to be given to a person when he receives his prescription. The handouts contain descriptions of the effects of the drug as well as cautions about activities, including driving after taking the drug.

The Alabama Department of Mental Health reported that it is currently distributing an article throughout the state on marijuana and Valium®, including the drugs' effects on driving. The distribution of the article is directed primarily at the state's female population between the ages of sixteen and twenty-six, which has been identified as a high risk group for abuse of the two drugs. The Do It Now Foundation of Phoenix, Arizona, reported that it has available to subscribers at a cost of five dollars a packet of materials on drug abuse. One of the pamphlets included in the packet is directed at use of alcohol and other drugs while driving.

The Minnesota Department of Public Safety in cooperation with the Minnesota Department of Vehicles is in the process of developing a brochure describing the effect of drugs, particularly marijuana, on driving. The Department of Motor Vehicles will include notice of the availability of drugs and driving information when it mails the motor vehicle registration forms to all licensed Minnesota drivers. A spokesman for the Minnesota Department of Public Safety estimates that about 36,000 copies of the materials will be distributed.

Several state traffic safety commissions reported that they regularly distribute literature to the public on driving safety, some of which may contain information on drugs and driving. The Texas Office of Traffic

Safety, in its weekly publication Driveline, has in the past mentioned the dangers of driving under the effects of drugs other than alcohol. The Florida Highway Safety Commission also reports distributing warnings about driving after taking drugs. While no other traffic safety agencies we contacted were able to identify any specific articles on drugs and driving, most of these agencies appeared aware of the dangers of driving under the influence of drugs other than alcohol and included some mention of it in the information that they disseminate to the public.

In addition to the state and local governmental agencies contacted, one private company (Eli Lilly and Company) reported PI&E activities related to drugs and driving. They distribute a Darvon Information Kit that includes information designed for physicians, pharmacists, and consumers. The materials in the kit contain cautions about the use of Darvon® while driving.

Federal Education Programs

Our major contact for identifying drug-driving education programs within the federal government was the Office of Personnel Management (OPM). OPM is responsible for coordinating the implementation of drug abuse programs within the different departments of the federal government. There are no programs for civilian employees within the federal government dealing specifically with drugs and driving. Each department is required to implement its own drug and alcohol abuse programs for its employees based on guidelines issued by the OPM.

Under the guidelines, any employee whose job performance is impaired by alcohol or drugs is confronted by his supervisor and requested to seek treatment. If he does not seek treatment, action may be taken against the person's employment status. In addition, the guidelines also require preventive programs designed to provide employees with information about drug abuse before job impairment is identified. The guidelines do not require a component on drugs and highway safety, but the topic may be touched on briefly in some department programs. Although departments are required to implement these programs, some have not because of resistance in some agencies to deal with drug problems and a lack of

resources.

The Department of Defense has the largest number of employees, including military and civilian personnel, of any department within the federal government, and appears to have the broadest range of education and treatment programs directed at drug abuse. Programs in the Defense Department that address drugs and highway safety occur within one of two settings. First, education and treatment programs directed at drug abuse in general may touch briefly on traffic safety, and second, traffic safety programs may include information on alcohol and drugs in relation to driving as one component.

The Office of the Assistant Secretary of Defense for Health Affairs is responsible for establishing the broad policy guidelines for drug abuse programs. It is then the responsibility of each service branch (Air Force, Army, Navy) to implement the guidelines. There is a good deal of variation within the three service branches as to how the guidelines are implemented. A spokesman for Health Affairs indicated that at the present time they have not developed any programs dealing explicitly with drugs other than alcohol and driving. They are, however, currently in the very early stages of planning a marijuana awareness program that would include a component on marijuana and driving.

Traffic safety programs, similar to drug abuse programs, are implemented within each military service branch under guidelines developed by the Department of Defense. As with the drug abuse programs, there is a great deal of variation in traffic safety programs among the three service branches.

Because of these variations, this discussion of drugs and highway safety programs within the Defense Department will address each branch of the military service separately. The first three sections will detail the programs for military personnel within the Air Force, Army, and Navy respectively. A fourth section will discuss any different procedures for civilian employees of the three service branches.

Air Force Education and Treatment Programs. The Directorate of Personnel Plans, within the Office of the Deputy Chief of Staff of the

Air Force for Personnel, is the office that develops and directs Air Force drug abuse programs. While drug abuse programs are managed at each individual installation, they are closely coordinated by the Directorate of Personnel Plans at the Pentagon.

According to a spokesman for this office, there are three principal drug abuse programs that address the subject of drugs and driving. First, all major Air Force installations have drug rehabilitation programs for military personnel identified as drug abusers. The relationship of drugs to highway safety is treated by using examples of studies of drugs and driver reaction times or by discussion of the dangers of driving while impaired by drugs. The proportion of the total rehabilitation program that addresses drugs and driving, however, is estimated to be very small (less than five percent). The primary focus is on illicit drugs.

All major Air Force installations also have alcohol and drug education programs for those persons who are convicted of driving under the influence. In almost all instances these convictions are for driving under the influence of **alcohol.** A small portion (estimated at five percent) of the education program touches on drugs other than alcohol and driving, but the primary emphasis is clearly on alcohol and driving.

There is a third method that the Air Force uses to disseminate drug abuse information. All military personnel are required to take a four-hour drug and alcohol program every time they report to a new duty station. There are two curricula for the course:

- Curriculum I — for Air Force enlisted personnel rank El to El4. This curriculum is designed to discuss personal abuse of drugs and alcohol.

- Curriculum II -- for all other enlisted personnel and all officers. This curriculum is designed to help a supervisor spot a drug abuse problem in his staff.

The percentage of the four-hour program that is specifically directed toward drugs and driving is once again estimated to be very small.

Since the emphasis of all three of these programs is directed at drug abuse in general and only tangentially related to drugs and driving, perhaps the greatest potential benefit derived from these programs is the

education of drug abusers who otherwise might drive while impaired by drugs.

There are three major components of the Air Force's traffic safety programs. Each of these briefly touches on drugs and driving:

- The Air Force Driver Rehabilitation Program is a ten-hour program on traffic safety. One hour of the program is devoted to alcohol and drugs, with about fifteen minutes of that hour directed toward drugs other than alcohol. The presentation consists of slides and videotape with periodic discussion breaks. The material presented deals primarily with the effect of drugs on driving behavior. The criteria for attendance at the program will vary from post to post but common criteria include: a specified number of moving violations; a DUIL conviction; or other criteria established by the unit commander. This program has been operational since 1969.

- A standard program in traffic safety is given to anybody who enters the Air Force. The program is four hours long, one hour of which is devoted to alcohol and drugs. It was estimated that ninety percent of the hour is devoted to alcohol.

- Driver magazine is published by the Air Force in cooperation with the other service branches. Its primary thrust is traffic safety. The February 1979 issue contained an article on driving under the influence of drugs, the first such article ever printed in the magazine.

According to a spokesman for the Air Force traffic safety program, it is believed that drugs other than alcohol and marijuana do not play a major role in traffic safety. Consequently, the focus of all Air Force traffic safety programs is on these two substances.

Army Education and Treatment Programs. Army drug abuse programs are coordinated through the Directorate of Human Resources Development in the Office of the Deputy Chief of Staff of the Army for Personnel. A spokesman for the office indicates that there is a great deal of latitude given to the structure and content of individual Army drug abuse programs.

In general, there are two types of Army drug abuse programs:

- Prevention programs designed to educate military personnel about the hazards of drug abuse. Attendance is mandatory for all military personnel and the length of the program will vary from post to post. A typical prevention program requirement is two hours every three months. The principal mode of instruction in prevention programs is film. The problem of drugs and highway safety is touched on very briefly.

- Rehabilitation programs are for Army personnel identified as having a drug problem. Referrals may come as a consequence of self-referral; results of required urinalysis; or arrests for drug related charges. Rehabilitation programs are held at every Army installation and are structured to last up to a year. The type of treatment provided includes group and individual counselling and detoxification. A very small portion of the program **may** include drugs and highway safety, but it is not a specific requirement.

Army traffic safety programs, like drug abuse programs, are left largely to the individual installations. Most Army posts model their traffic safety programs after the National Safety Council's Defensive Driving Course. The typical program is an eight-hour course interspersed with films. One to two hours are devoted to the effect of alcohol or drugs on driving, with the emphasis clearly on alcohol. All uniformed personnel twenty-six years or younger are required to take the course. While each army installation is free to develop its own programs, the Defensive Driving Course is used as a guideline.

Navy Education and Treatment Program. The Office of the Assistant Deputy Chief of Naval Operations for Human Resource Management is responsible for administering Navy drug abuse programs. Most of the drug abuse programs at naval installations are managed from the Alcohol Rehabilitation Center at the San Diego Naval Station in California. There are two basic drug abuse programs:

- The Naval Alcohol Safety Action Program (NASAP) is the "front end of the funnel" for most naval personnel entering the alcohol and drug rehabilitation system. Modeled after the Alcohol Safety Action Program concept developed by the U.S. Department of Transportation, it is a

thirty-six-hour course designed to provide drug and alcohol abuse education. The primary emphasis is on alcohol; however, other drugs are included in the program. Traffic safety is a primary emphasis of the program, but a spokesman for the Navy's drug abuse program could not estimate the amount of effort devoted to drugs other than alcohol and traffic safety. Naval personnel are referred to the NASAP as a result of arrests for DUIL, or other alcohol or drug offenses, as well as other behavior that identifies them as substance abusers. Most of the referrals to the NASAP are as a result of alcohol charges. It is estimated that less than three percent of the referrals resulted from drug charges. It is stressed, however, that a much greater percentage of the people seen by the NASAP have problems with drugs in addition to alcohol. The NASAP is the Navy's primary interface with the civilian community. Naval personnel that are arrested off-base are required by the civilian courts to participate in the NASAP program.

- Naval Alcohol and Drug Rehabilitation Programs are designed for naval personnel who need treatment for alcohol or drug abuse. Clients may be referred to rehabilitation after completion of the NASAP program, or if the case warrants it, they may be referred directly to rehabilitation. There are four types of rehabilitation programs throughout the Navy. Fifty Counselling and Assistance Centers are located at Navy bases and on ships providing short-term drug abuse treatment. There are twenty-four Alcohol Rehabilitation Centers that provide outpatient alcohol and drug treatment with the primary emphasis on alcohol treatment. Finally, three Alcohol Rehabilitation Centers provide inpatient alcohol and drug abuse treatment, and one Drug Rehabilitation Center specializes in inpatient drug treatment. All of the Navy rehabilitation programs may at some point discuss drugs and highway safety, but it is not a specific requirement of any of the programs.

The primary Navy traffic safety program dealing with drugs is an eight-hour traffic safety course given to all naval personnel twenty-six years old or under. The course is given at naval induction sites throughout the country. These sites are:

- Newport, Rhode Island;
- Great Lakes, (Chicago), Illinois;
- San Diego, California;

- Orlando, Florida;
- Pensacola, Florida; and
- The Naval Academy, Annapolis, Maryland.

The course is a multimedia presentation with about forty-five to forty-eight minutes devoted to alcohol and drugs. A spokesman for the Naval Safety Center reported that there is a good deal of emphasis on drugs other than alcohol.

In addition to the development of the traffic safety course, the Naval Safety Center also works closely with the NASAP in San Diego. Since the NASAP places a heavy emphasis on driving safety, the Naval Safety Center distributes information throughout the Navy on the NASAP program.

Education and Treatment Programs for Civilian Employees within the Service Branches. According to a spokesman for the Air Force, the procedures used for civilian employees are essentially the same as for military personnel. When a drug-related job impairment is identified, the employee is referred to a drug counselling program. Depending on the facilities available, the program may be internal or it may be provided by a community agency. The major difference between civilian employees and military personnel is that civilians cannot be required to attend treatment programs. If the civilian is referred to a treatment program, he may choose the one he wishes to attend or he may refuse to attend altogether. The only consequence of such a refusal is that, if the employee's job performance continues to affected by the problem, he may be disciplined or fired. The range of treatment programs available to civilian personnel is essentially the same as that available to military personnel. The Air Force has no programs aimed directly at drugs and highway safety, but drug abuse programs may mention the topic briefly.

The number of civilians found to have drug problems and referred to treatment is not large. Last year the Air Force identified thirty-three civilians as having a drug problem compared to thirteen hundred civilians identified as having an alcohol problem. Nevertheless, according to a spokesman for the Air Force, the Department of Defense's programs for civilians are considered to be one of the most developed among all

federal departments.

Federal PI&E Programs

Contacts with federal agencies revealed relatively little activity in the area of PI&E related to drugs and driving.

The Drug Enforcement Agency (DEA) of the United States Department of Justice reported a small amount of activity with respect to drugs and driving. Its primary responsibility is to enforce federal drug laws; however, a spokesman for the DEA reported that it distributes literature to interested individuals or agencies about drugs in general. The information is sent to anyone upon request and includes a drug symptoms chart that mentions the effects of drugs on driving.

The Food and Drug Administration of the Department of Health, Education, and Welfare periodically conducts PI&E campaigns that touch on drugs and driving. The September 1978 edition of the FDA Consumer, its monthly magazine, contained an article on the dangers of driving after using drugs. Also, the FDA, along with the Surgeon General of the United States, recently issued an advisory to all medical professionals to take greater care when prescribing a broad range of drugs to alcohol users. Included in the advisory was the warning that driving skills may be adversely affected.

SUMMARY

Both the literature and our contacts with operational agencies indicate little activity in the area of information and education countermeasures for drug-impaired drivers. Only three out of 190 state and local agencies contacted said they had specific education or information programs on drug and driving referrals. All three of these programs were in the driver education category. No state or local agency reported having specific drug-driving programs in the areas of general health education, substance abuse education, professional medical education, or professional education for highway safety specialists.

The contacts indicated that the U.S. Department of Defense (DOD) has an extensive program in the area of drugs. Both education and treatment

are included. There are separate DOD programs for traffic safety. Several drug programs and traffic safety programs have components that deal with drug-impaired driving.

Some federal PI&E activities in the drug and driving area were found in our contacts, but the amount of activity was much less than that in the areas of education and treatment.

CHAPTER NINE

CONCLUSIONS AND RECOMMENDATIONS

With the exception of alcohol, present knowledge does not establish any drug as a priority highway safety concern. Research has established that many drugs have the potential to impair driving behavior and that these drugs are used by people who drive. Research findings and reports of operational agencies document crashes that involve drivers who have used drugs. Drivers arrested for impaired driving are found to have used drugs--alone and frequently in combination with alcohol or other drugs. **The frequency with which drug-impaired drivers drive and are involved in crashes is not known.** The frequency of arrests for drug-impaired driving is much less than that for alcohol-impaired driving. Preliminary data suggest that about one hundred arrests are made for alcohol-impaired driving for every one arrest for drug-impaired driving. Estimates for crash involvement cannot be made on the basis of existing data.

Present knowledge supports the need for further inquiry to establish the nature and magnitude of the drug and driving problem. While objective data do not exist to support statements that the drug and driving problem is increasing, it is the perception of operational personnel (police, prosecutors, health specialists, drug abuse experts, and highway safety specialists) that the problem has increased in recent years. These views should not be ignored. They support research findings that indicate the need for careful inquiry to develop the necessary objective data to define the problem. Of greatest need are epidemiologic data on drug use among drivers representative of crash- and noncrash-involved populations.

Present knowledge also indicates that examination of the drug and driving problem should consider a broader range of drugs than controlled substances and marijuana. Other psychoactive drugs, including antidepressants, major tranquilizers, outpatient anesthetics, and

medications available over the counter for self-treatment are also of interest. **Present knowledge about marijuana and driving is incomplete and does not support or refute arguments that marijuana should be a significant highway safety concern.**

Knowledge about the patterns of drug use suggest that polydrug use should be a major concern. In particular, the use of drugs and alcohol in conjunction with driving is a priority interest. Such use may produce impairment deliberately when drugs are abused or inadvertently when medications are used in combination with social drinking.

The state of knowledge suggests directions for the future. Efforts need to be undertaken to define the problem. Some current actions can be taken on the basis of existing knowledge. There are major policy issues that should be examined to focus future activity. These topics are discussed below.

PROBLEM DEFINITION: FUTURE NEEDS

Experimental Research

Past research, with few exceptions, has been fragmentary, lacking in depth, and has uncertain meaning for the practical concerns of highway safety. Some drugs have been studied many times, with mixed results; findings for many others are scarce indeed. Some ongoing research efforts identified earlier in this report are comprehensive attempts to avoid these problems. Future studies to advance the state of knowledge must address the following crucial issues:

- How can experimental research **realistically** determine whether a drug, as commonly used by the general (driving) population, presents a hazard to highway safety?

  To be relevant to highway safety, characteristics of drug use and of people using drugs should be matched in studies of drug effects on driving performance. Any substance (including water), ingested in sufficient quantity, can impair human performance. On the other hand, precise laboratory tests can measure significant changes in measures of performance that may have little practical meaning for actual driving. Among alternatives suggested

to resolve this dilemma is the comparison between other drugs and alcohol at a blood concentration equal to present legal standards (0.10% w/v BAC). This approach, however, may not be fruitful. Other drugs have effects different from alcohol that may require different measures of performance. Moreover, alcohol impairs certain skills at BACS of less than 0.10% w/v. This issue deserves further study if research on drug effects is to fulfill its purpose to assess the potential of drugs to increase the likelihood of traffic crashes.

- How can we better measure the effects of drugs on human behavior or skills related to actual driving performance?

  Basic research on the actual driving task has not been sufficient to satisfy the need for valid and reliable measures of driving performance. To be relevant, experimental research on drugs and driving requires better methods to estimate the potential of drugs, alone and in combination, to impair driving ability. Research on the driving task to support the development of such methods should be undertaken at a greater level of effort than in the past.

- By what standards can we judge that a drug—or combined drugs—renders a person incapable of driving safely?

  Legally, blood alcohol concentration (BAC) is a standard by which impaired driving is measured. For other drugs, equivalent measures are theoretically possible, but at present have not been established. Differences in the way people respond to drugs and the variance in the amounts of drugs in the blood are large--great enough to confound many studies that attempt to correlate concentrations of drugs with their effects. BAC-equivalents for other drugs may never be developed. Alternative approaches to measuring impairment, for example, roadside behavioral tests, should be examined.

- Which experimental designs most effectively serve to assess the effects of drugs and combinations of drugs?

  The effects of drugs vary and depend on many factors, including dose, frequency of use, time of use, physiological and psychological conditions, and ability to compensate. For example, therapeutic drugs may **enhance** driving performance in patients requiring them for medical treatment. Designs of experimental studies should allow examination not only of impaired performance per se, but

also of factors operating in the real world that may mitigate the adverse effects of drugs.

Epidemiologic Research

The purpose of experimental research is to assess the potential highway safety risk of drugs. Studies of drug effects on skills believed related to driving cannot establish that drugs actually increase the likelihood of traffic crashes. This is the function of epidemiologic research.

Lacking in past research on the use of drugs by drivers has been comparisons between populations of drivers involved in traffic crashes and drivers at risk. Without such comparisons, no objective statement about the relative probability of a drug-involved crash is possible. Complete epidemiologic studies are very much needed now.

In-depth investigations of drug-involved crashes have rarely been attempted. The presence of drugs—and to some extent their effects—can be determined. To establish that a drug contributed to the occurrence of a traffic crash requires closer study. Epidemiologic research similar to that for alcohol is necessary to demonstrate a strong association between drugs and traffic crashes.

Among issues that must be addressed in future research are (1) the accumulation of data linking drugs and traffic crashes; and (2) the comparability of separate studies. Exploratory research on the prevalence of drugs in different driving populations should emphasize the analysis for a broad range of drugs at therapeutic (or effective) concentrations in the blood. Efforts by state and local agencies should at least include those drugs of greatest interest to highway safety at these concentrations. To enhance the quality of data obtained, additional support for state efforts from highway funds should be considered to increase the analytic capability of operational agencies.

The importance of studying the use of drugs by drivers who have not crashed (the population at risk) cannot be stressed enough. Nonetheless, substantial constraints on research exist. Studies of research methodology to identify approaches that result in acceptable levels of cooperation by

drivers stopped at roadside should be done prior to large-scale surveys. This kind of research is costly, and carefully designed, well-coordinated efforts will ensure that comparable benefits will be derived.

Drug use among fatally injured drivers, however well described, does **not** indicate the true magnitude of the drug and driving problem. Crashes resulting in injuries requiring costly medical treatment and incurring other societal losses are much more frequent. Drugs other than alcohol may contribute much more substantially to these kinds of crashes. Crashes that produce injury but not death may be more typical of the less impairing, more subtle effects of other drugs on driving skills. Yet, the prevalence of drugs among drivers **injured** in traffic crashes is virtually unstudied.

Some research on drug use by injured drivers is both ongoing and planned. Efforts by hospital emergency departments to determine the presence and amount of drugs in crash-involved drivers could lead to an accumulation of data to supplement formal research projects. How many hospitals have the necessary analytic capability to conduct such work is not known. Such efforts should be encouraged where feasible and, if necessary, supported.

Other sources of information on patterns of drug use and driving can be tapped as well. National, state, and local questionnaire studies concerned with drug use or abuse should include questions related to highway safety and respondents' drug and driving experience. Despite problems with this kind of data (in particular, their nonspecificity with respect to single drug entities), some assessment of pertinent attitudes and behavior in different driving-age populations that use drugs—both licit and illicit—would assist in estimating the scope and magnitude of the drug and driving problem.

The widespread use of drugs that affect behavior and the ubiquitous use of motor vehicles lend credence to the drug and driving issue. Research should proceed on several fronts, both experimental and epidemiologic. These approaches to defining the problem are complementary, each requiring the other.

Methodology in Experimental and Epidemiologic Research

To enhance the quality and relevance of drug and driving studies, continued research and development efforts are needed in both experimental and epidemiologic areas.

Criticism of experimental studies on the effects of drugs has pointed to deficiencies in behavioral methods. The validity of tests that purport to measure driving-related skills has been openly questioned. Better techniques and methods to assess driving skills and performance would benefit areas other than drugs and driving, for example, driver licensing. Yet, support of basic research to advance the state of the art has not been forthcoming.

Research and development needs include the following:

- basic research on the actual driving task, to improve understanding of required performance skills and other factors that influence driving;
- development of laboratory techniques to reproduce the driving task more exactly and completely;
- analyses of present methods used to measure drug effects in order to identify which basic skills are being tested; and
- validation of laboratory and other tests by intermethod comparison.

Operating motor vehicles is a basic way of life in the United States. Driving mishaps are a significant cause of death among young adults and cause the loss of billions of dollars annually. Funds expended to increase our understanding of safe driving performance and our ability to measure deficits in skills required to drive safely would seem well spent.

Methodological issues in epidemiologic research have received more attention. The ongoing development and evaluation of methods to detect and measure drugs in body fluids have been described in this report and should continue. The comparability of analytical results among different laboratories remains uncertain at best, especially for quantitative measurements. Until quality control and proficiency testing programs establish the validity of comparing data from separate sources, a single,

qualified laboratory should be used in projects where findings must be consistent for later comparison and interpretation.

Methodology for roadside surveys is one area that requires much more research and development. International groups and independent researchers have devoted much effort to improve methodology for research on alcohol use among drivers. Approaches to roadside surveys for alcohol depend on breath testing; breath specimens are more simply obtained but are presently useless for measuring other drugs. Because roadside surveys to study other drug use are so important, specific methodology to support these studies must be developed and tested.

Integration and Transfer of Information on Drugs and Highway Safety

As a whole, drugs and highway safety includes several areas of research, involving many disciplines. At the same time, action programs to deal with the drug and driving problem have been initiated at state and local levels. With increasing interest in this subject and increasing activity, there is a need to integrate and transfer information relevant to drugs and highway safety. A central clearinghouse for information on drugs and driving would serve:

- to maintain and update collections of literature and other documents pertaining to all topic areas including research, methodology, legislation, and action programs;
- to prepare bibliographies that provide ready reference to sources of information; and
- to provide upon request information that can be used by researchers and practitioners alike.

In addition to collecting and disseminating research reports and other information on drugs and driving, this hypothetical center could collect state and local data on the detection and measurement of drugs in drivers, integrate findings from contributing agencies, and analyze the continuous flow of information from the field. The basic function of such an information clearinghouse would be to interface between **research** to define the problem and **action programs** to deal with the problem. The

complex area of drugs and highway safety needs a resource center to which state and local officials can turn to for information and other support. This kind of center could facilitate the establishing of networks among state and local agencies facing similar problems and engaged in similar activity.

CURRENT ACTION ITEMS

Present knowledge about drugs and driving supports action in several operational areas of highway safety. Action is needed to enact **effective** laws making driving under the influence of drugs illegal as well as to facilitate the detection, apprehension, prosecution, adjudication and sanctioning of drug-impaired drivers (see Chapter Seven).

Knowledge about drugs that have the potential to impair driving needs to be shared with those who use them and with those who have responsibilities for highway safety management. What is known can be shared through inclusion of drug and driving information elements in existing education and public information programs that address both drug and highway safety issues (see Chapter Eight).

What is known also needs to be considered as decisions are made to allow additional substances to enter the marketplace. The introduction of new drugs similar to those shown to have the potential to impair driving and which are identified as playing causative roles in traffic crashes should occur only after the acquisition of evidence that allows a complete weighing of the risks and benefits of the drug. The risk potential of a new drug to highway safety should be included in this risk benefit analysis. This responsibility falls within the purview of the Department of Health, Education, and Welfare and its agencies.

The previous two action items are more closely related to highway safety and, thus, are discussed in greater detail below.

Driver Control Laws

The existing state driver control laws intended to prevent driving under the influence of marijuana or other drugs are in disarray. A drug-impaired driver may escape prosecution because a chemical test

cannot be requested; by choosing a test (e.g., breath) that will not reveal the drug being used; by using a substance that does not fit a narrowly defined category of "drugs," or by using drugs and alcohol in combination. Some of these loopholes exist in the laws of all but twelve states. Law revision is needed, if the legal system is to be used as a deterrent to drug-impaired driving.

The need for effective laws has been recognized by the drafters of the Uniform Vehicle Code. Model legislation has been drafted that addresses each of the issues identified briefly above and in greater detail in Chapters Six and Seven.

States should be encouraged to substantially adopt the provisions of the Uniform Vehicle Code related to alcohol, other drugs, and driving.

The experience of the states that adopt new laws and of those states that now have similar provisions in effect should be evaluated. Problems in enforcement, prosecution, adjudication, and sanctioning should be identified. The effectiveness of legislation in ameliorating such problems should be assessed.

The National Committee on Uniform Traffic Laws and Ordinances should be supported to assist states in developing legislation and, if necessary, to revise the Uniform Vehicle Code to address new problems.

Information and Education

While the existence of a serious drug and driving problem has not yet been confirmed by research, there is sufficient evidence of a potential problem to warrant some effort to promote public awareness. Large-scale public information and education (PI&E) campaigns and other special programs requiring heavy expenditures are not appropriate because of the lack of a knowledge base to support such efforts. On the other hand, limited use of existing programmatic structures (for example, NHTSA's 402 program) is indicated. Information and education modalities should include:

- driver education,

- general health education,
- drug abuse/substance abuse education,
- professional medical education,
- professional education for highway safety specialists, and
- public information and education campaigns for both general and special (for example, pharmacists) audiences.

A major shortcoming of existing information and education programs dealing with drugs and driving is their fragmented nature and the lack of comprehensive approach to the problem. Most present programs deal with drugs and driving peripherally as a part of some other topic (for example, alcohol-safety). Mechanisms for developing a more integrated approach dealing with all aspects of the drug-driving problem need to be expressed.

Finally, no information and education program in this area can succeed without effective materials. A first step in developing such materials is the in-depth analysis of the content and methods of present programs. The results of this effort should be collated, indexed, and made available to researchers and practitioners in the field.

POLICY ISSUES

The experience of our nation with alcohol and highway safety is a driving force in the planning of research and operational programs focused on the perceived problem of drugs and highway safety. Research is underway to assess the magnitude of the problem created by drug use by the driving population. Experimental research seeks to define the relationship between drug concentrations in the body and driver impairment. Epidemiologic research seeks to identify the actual risk of various drugs to highway safety. Countermeasures that have been used to deal with alcohol--legal, health, education, and public information—are under development and limited implementation. In particular, the establishment of a BAC-equivalents, objective measures of impairment, is sought.

The perception that it is possible and desirable to establish a

quantitative measure--a "body drug concentration" (BDC)--that is indicative of driver impairment has either explicitly or tacitly become a major premise underpinning research and operational planning. Legal practitioners, police, prosecutors, and judicial personnel seek a BDC that can be used to prove impairment as the BAC is used for alcohol. As reported in Chapter Seven, the absence of such an objective measure is seen as a major reason for the low frequency of arrests, prosecutions, and convictions for drug and driving offenses.

Experimental research is underway for major drugs of interest to develop more detailed information on the relationship between concentrations of drugs in the body (e.g., blood drug concentrations) and effects on tasks believed related to driving. These efforts are important but they are costly and will take time. Practical limitations (such as the availability of qualified researchers with adequately equipped laboratories, the time required to perform tests, and the availability of funding) make it unlikely that dose-effect relationships can be established for more than a few drugs in the next five years. Thus, it is unlikely that the meaning of a specific BDC for many drugs of interest will be known. Of course, if a BDC was so great as to indicate gross impairment—for example, a BDC indicating severe drug abuse or a suicide attempt--a specific BDC would have some meaning; however, that meaning could be derived in most cases from existing knowledge. The experimental work now underway properly seeks to increase our knowledge about more subtle effects than gross impairment.

The development of drug-effect relationships is also constrained by the pharmacokinetics of drugs. Almost all psychoactive drugs are more complex than alcohol. Individuals respond differently to the same dose or the same drug concentration. Chronic users can tolerate higher doses than do individuals receiving a single dose of some drugs. Unlike alcohol, a single BDC value will be difficult, if not impossible, to develop for many of the more complex drugs.

The reliance on the BAC value for alcohol as the indicator for countermeasure action created a requirement for extensive chemical test programs. Equipment now exists to rapidly, nonintrusively, reliably, and

inexpensively quantitate the alcohol concentration in a driver's breath. The chemical tests can be administered by police officers who have received about one week's specific training. In contrast, chemical tests for other drugs must be performed on body fluid specimens other than breath. Blood is presently the body fluid of choice and it is unlikely that this will change for many drugs in the near future. Chemical testing is accomplished in a laboratory setting using relatively sophisticated instrumentation and requires professional supervision. Costs are relatively high when compared with alcohol testing. Specific tests for a single drug or drug class are likely to be both less expensive and easier to perform in the future. Use of these methods requires prior knowledge of what drug is sought. In the absence of knowledge that a particular drug is present in a specimen, screening methods capable of detecting likely substances that could impair driving must be performed. Now, and in the forseeable future, testing of this nature will be costly. The cost of drug screening methods has limited their use. Chemical analysis of body fluid specimens has been reserved for serious criminal or civil cases usually involving death. Even if funds were available, there are not enough personnel or facilities in existence today to perform complete chemical tests for all cases of suspected drug-impaired driving. Even if the capability existed to test in all cases, the present state of knowledge would not allow full understanding of the results.

If the alcohol experience is used as a guide and a BAC equivalent (a BDC) is sought for each drug of interest, a number of trends are foreseeable.

- A very large-scale experimental research effort will be necessary to develop BDCs for drugs of interest. This may not be possible for all drugs.

- State laws will have to require drivers to provide blood specimens for chemical tests. This will require, in turn, legal, operational, and public acceptance of this countermeasure approach. The likelihood of acceptance is unknown.

- A large-scale effort will be necessary to create a capability in states and major localities to perform

chemical tests for drugs other than alcohol. This will require significant funds, the training of personnel who are not now identified, and physical facilities that do not now exist.

- The BDC concept will have to be accepted by the courts. Given the present state of knowledge, this will require extensive litigation. For the foreseeable future, expert testimony will be required to present chemical test evidence and interpret the findings. Prosecution of cases based on chemical tests will be costly.

Each of these trends will require funds and effort. Given the limited availability of local funds and resources, such a response is unlikely to occur unless drugs and driving is established as a major highway safety problem. To gauge the response it may be useful to turn to the alcohol experience. Even though alcohol is unquestionably a far more significant problem than any other drug, the state and local response has been limited. To expect more for other drugs is probably unrealistic.

This suggests that, at this point in the examination of the drug and driving problem, some basic policy analyses should be performed. The wisdom of following the alcohol experience should be carefully examined. In particular, the feasibility of developing and relying on a BDC for drugs other than alcohol should be evaluated. The feasibility of using alternative methods of proof of drug and driving offenses should be examined. This examination should include a detailed review of the feasibility of using the criminal law system as the major social control system for drug-impaired driving. Alternative control measures that rely on administrative approaches using nonpenal sanctions should be considered.

The state of knowledge clearly suggests that analysis of such policy issues is warranted as the drug and driving problem is examined and defined. The evidence is sufficient to allow us to urge consideration; it is beyond the scope of this report to resolve these important policy questions.

APPENDIX A

SUMMARY OF METHODOLOGICAL ISSUES IN EXPERIMENTAL RESEARCH ON DRUGS AND DRIVING

TABLE A-1

SUMMARY OF METHODOLOGICAL AND OTHER ISSUES IN EXPERIMENTAL RESEARCH ON DRUGS AND DRIVING

CATEGORY OF ISSUE	EXAMPLE	CONSEQUENCE
DRUG:		
Dose	low, therapeutic doses of drugs used; different studies employ different doses	effects of higher than therapeutic doses associated with misuse or abuse not known; lack of comparability among studies
Number of Different Doses	only one or two doses studied	relationship of dose and effect not characterized
Number and Frequency of Doses	most studies examine the effects of a single drug administration	differences between acute and chronic use of drugs, the latter more common with therapeutic drugs, remains unknown; tolerance, effects of drug accumulation, not studied
Drug Combinations	single dose combinations of drugs, usually alcohol plus other drug, reported	lack of systematic study limits knowledge of the possible significance of polydrug use to highway safety
Placebo	impure placebos, with possible effects on behavior used as controls; placebo effect may cause behavioral changes	inappropriate comparisons between control and experimental groups, may lead to lower estimates of risk liability
SUBJECT:		
Screening and Control	no assessment of prior drug experience or current use by subjects; evaluation and monitoring of psychological and physiological states of subjects not done	increased variability of response to drug effects (e.g., tolerance in alcohol users to effects of depressant drugs)

TABLE A-1

SUMMARY OF METHODOLOGICAL AND OTHER ISSUES IN EXPERIMENTAL RESEARCH ON DRUGS AND DRIVING (Continued)

CATEGORY OF ISSUE	EXAMPLE	CONSEQUENCE
SUBJECT (Cont'd):		
Selection	difficulty in using females of child-bearing age; use of college students as subjects; normal, healthy subjects instead of patients	experimental subjects usually not representative of population that uses drugs, especially psychotherapeutic agents prescribed for medical conditions
Number	in most studies, very small groups of subjects used	studies may not detect drug effects that will occur in general population; unusual sensitivity to drugs may go undetected
TECHNIQUE/METHOD FOR MEASURING RESPONSE TO DRUG:		
Development	research on behavioral methodology is specific to discipline, often without reference to real world activity	methods that can detect drug effects may not be relevant even though variables measured have some relation to driving
Selection	research on driving; related skills employs methods selected not for their relevance to driving but because they are available to the investigator	results of these studies are indicative of drug effects on human performance but are not necessarily related to driving performance
	complex tasks involve many skills	uncertain which skills affected by drugs are reflected in performance scores
	skills or behaviors measured not critical to driving	results of studies largely irrelevant to applications in highway safety

TABLE A-1

SUMMARY OF METHODOLOGICAL AND OTHER ISSUES IN
EXPERIMENTAL RESEARCH ON DRUGS AND DRIVING (Continued)

CATEGORY OF ISSUE	EXAMPLE	CONSEQUENCE
TECHNIQUE/METHOD FOR MEASURING RESPONSE TO DRUG (Cont'd):		
Similarity of Methods	groups of tasks with common behavioral measures have different performance requirements	conflicting results fill the literature, confusing the assessment of a drug's effects
Number of Tests	studies often test subjects with a few methods that do not cover the range of possible drug effects	definitive studies of drug effects are lacking; literature becomes filled with fragments of findings that cannot be compared or even evaluated
Specificity	behavioral methods developed to measure certain kinds of drug effects are used inappropriately to study other kinds of drug effects	significant drug effects may be missed; erroneous conclusions about the potential of drugs to increase highway safety risk
Validity	artificial laboratory tests have limitations as valid predictors of drug effects on actual driving; these limitations rarely addressed in research reports	tendency to rely solely on experimental literature as definitive of drug and driving problem is encouraged

TABLE A-1

SUMMARY OF METHODOLOGICAL AND OTHER ISSUES IN EXPERIMENTAL RESEARCH ON DRUGS AND DRIVING (Continued)

CATEGORY OF ISSUE	EXAMPLE	CONSEQUENCE
EXPERIMENTAL DESIGN:		
Sources of Variability	lack of attention to intervening variables that influence the effects of drugs (subject differences [sex, weight]; differences in drug-body interactions [absorption,metabolism]; behavioral changes over time [acute tolerance to drug effects, enhanced performance due to practice]; ability to compensate for drug effects)	increased variability in results, especially among small groups of subjects; results rendered statistically insignificant though many subjects are substantially affected by drug; conclusions about potential of drugs to impair driving performance in the general population prevented
Time(s) of Testing	testing of subjects at inappropriate times; lack of behavioral testing over full duration of drug effects, including residual effects	information on drug effects often does not relate to times of peak effects; assessment of drug effects not complete
Repeated Tests	failure to establish baseline performance of subjects gives rise to improved performance due to practice; drug effects on learning new behavior may be measured more than skills performance	increased intersubject variability; lack of realism in study: driving is an "overlearned" task, with skills that may be stable through practice and resistant to drug effects

TABLE A-1

SUMMARY OF METHODOLOGICAL AND OTHER ISSUES IN
EXPERIMENTAL RESEARCH ON DRUGS AND DRIVING (Continued)

CATEGORY OF ISSUE	EXAMPLE	CONSEQUENCE
EXPERIMENTAL DESIGN (Cont'd):		
Inclusion of Variables	failure to measure important variables, including: (1) concentration of drug at time of testing, and (2) subjective assessments of performance	valuable data lost, including: (1) relationship of performance changes to concentration of drug in body fluids of subjects, and (2) comparison between subject's awareness of drug effect and objective measures of performance; ability of subjects to compensate for perceived effects of drugs
REPORTING OF RESEARCH:		
Methods of Behavioral Measurement and Data Analysis	incomplete reporting of methods used, subjects tested, and times of testing	evaluation of results of experimental studies rendered difficult if not impossible
Findings of Experimental Studies	stating of conclusions not warranted by results; inferences based on data that cannot be generalized	misleading statements about drug effects and their implications for highway safety
Publication	reports of experimental research scattered throughout many journals, other information sources (e.g., NTIS)	assembly and review of relevant literature becomes a separate task in evaluating drug and driving research

APPENDIX B

DEFINITIONS OF DRUGS IN STATE DUID STATUTES

TABLE B-1

DEFINITIONS OF DRUGS IN STATE DRIVING UNDER THE INFLUENCE OF DRUGS (DUID) STATUTES

STATE	DRUG DEFINITIONS USED				
	ANY DRUG	NARCOTIC DRUG	CONTROLLED SUBSTANCES	SPECIFIED DRUGS	OTHER DEFINITION OF DRUG
Alabama		X			
Alaska		X			X
Arizona	X				
Arkansas	X		X		
California	X				
Colorado	X	X			
Connecticut	X				
Delaware	X				
Florida			X	X	
Georgia	X				
Hawaii	X				
Idaho	X	X			
Illinois	X	X			
Indiana			X		
Iowa	X	X			X
Kansas	X	X			X
Kentucky	X				
Louisiana		X		X	X
Maine	X				
Maryland	X		X		
Massachusetts		X		X	X
Michigan			X		
Minnesota			X		
Mississippi		X		X	X
Missouri					X
Montana	X	X			
Nebraska	X				
Nevada			X		X
New Hampshire					X
New Jersey		X			X

TABLE B-1

DEFINITIONS OF DRUGS IN STATE DRIVING UNDER THE INFLUENCE OF DRUGS (DUID) STATUTES (Continued)

STATE	DRUG DEFINITIONS USED				
	ANY DRUG	NARCOTIC DRUG	CONTROLLED SUBSTANCES	SPECIFIED DRUGS	OTHER DEFINITION OF DRUG
New Mexico	X	X			
New York					X
North Carolina	X	X			
North Dakota		X	X		
Ohio					X
Oklahoma	X		X		
Oregon		X			X
Pennsylvania			X		
Rhode Island		X		X	X
South Carolina		X			X
South Dakota			X	X	
Tennessee		X		X	
Texas			X		X
Utah	X				
Vermont					X
Virginia		X			X
Washington	X				
West Virginia	X		X		
Wisconsin			X		
Wyoming			X		

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