

ALCOHOL AND HIGHWAY SAFETY

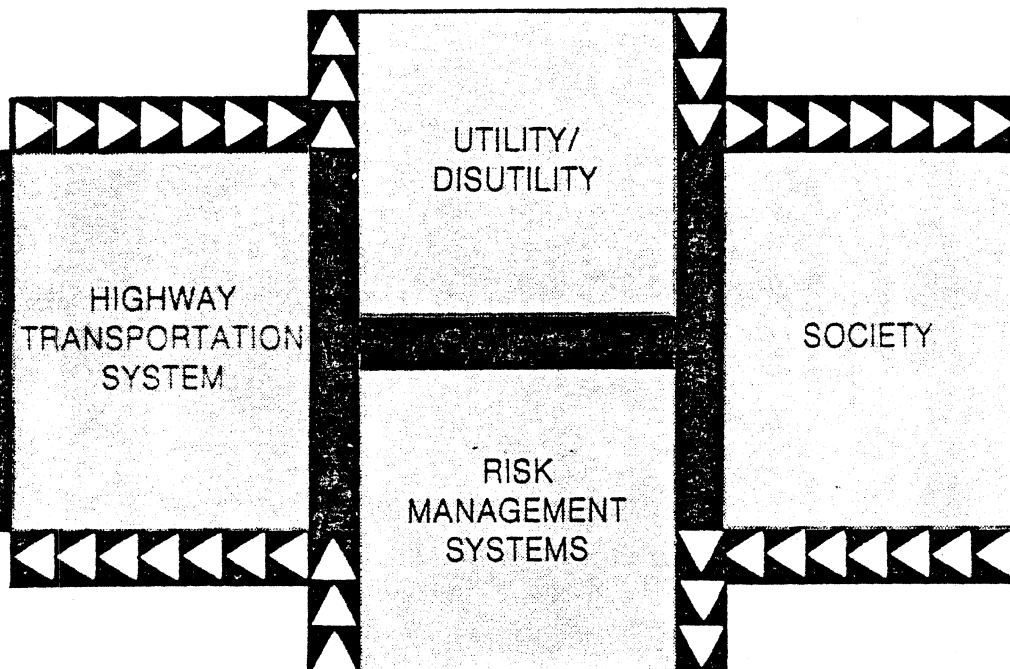
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March 1981

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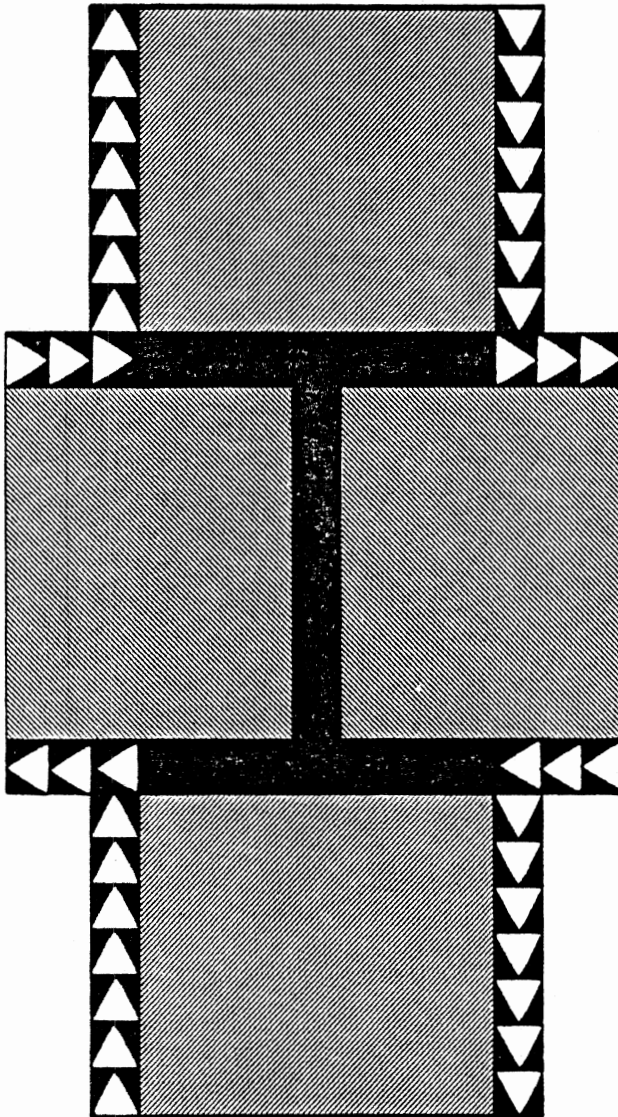
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Epidemiological and experimental studies indicate that alcohol-impaired drivers are a cause of a large number of traffic crashes. It is estimated that such crashes generate costs to society in the order of \$10 billion or more. Society has responded to the alcohol-crash risk by using a variety of approaches. Chief among them is the legal approach that is based on deterrence: the threat of punishment is used to prevent individuals from driving while impaired. Other approaches, including health, public information and education, and technology, complement the traditional legal approach, and these are often used simultaneously. However, society's efforts to control the risk of drinking driving generally have not had much of an effect on the problem.

This paper identifies the alcohol-crash risk, describes society's principal strategies and tactics for reducing this risk, discusses the relative success of these efforts, and presents recommendations for appropriate action against the problem of the drinking driver.

Introduction

The alcohol-crash problem probably has received more attention over a longer period of time than any other area in the field of highway safety. Long before any other highway safety topic had been made legitimate as a subject for "serious" inquiry, drunken drivers of "automobile wagons" were being written about in scientific journals. The now-famous quote in a 1904 issue of the *Quarterly Journal of Inebriety* contains what surely must be one of the first epidemiologic findings on this subject, that nineteen drivers involved in twenty-five fatal accidents had "used spirits within an hour or more of the disaster." The article went on prophetically to predict that "accidents of this kind will surely multiply," one of the more notable successes in the history of long-range forecasting.

Despite this early start, scientific study of the alcohol-crash risk did not progress far until the 1930s, when a series of epidemiologic and experimental studies began to sketch out the broad dimensions of the problem. Epidemiological studies seek to determine the prevalence of alcohol in both crash- and non-crash-involved drivers, while experimental studies are conducted to determine what effects a given quantity of alcohol has on skills related to driving. These studies have continued to the present time and are still continuing. They clearly show that alcohol-impaired drivers are a cause of a large number of highway crashes in the United States. The studies also provide information about the nature of alcohol-related crashes and the drivers who are involved in them.

40% to 55% of all the fatally injured drivers tested had BACs of .10% w/v or more. These drivers were too intoxicated to legally drive a motor vehicle in most states.

The results of these risk-identification studies are summarized briefly below. The difficulty in developing hard-and-fast numbers for such a complicated phenomenon will become apparent. This is because of the lack of nationwide epidemiologic studies and because local studies

have been conducted at different times over a long time period, and their objectives, methods, and execution have varied widely. A more fundamental difficulty in estimating the magnitude of alcohol-crash risk is that most epidemiologic studies have been concerned with alcohol involvement in crashes rather than alcohol as a causal factor in crashes. That a driver has been drinking does not necessarily mean that alcohol caused the driver to crash. Causes other than alcohol also must be eliminated. A combination of epidemiologic and experimental results are needed to address the question of causality, and even then, only rough estimates are possible. In this paper we use the number and percentage of crashed drivers with blood alcohol concentrations (BACs) of .10% w/v or greater as measures of the magnitude of the alcohol crash problem. (A BAC of .10% is the legal limit for alcohol intoxication in most states.) While it cannot be said that all crashes involving such drivers are caused by alcohol, there is much evidence that one's risk of a crash is much higher at such BACs than at BACs approaching zero.

Identifying the Alcohol-Crash Risk

Alcohol and Traffic Crashes

Epidemiological studies of the alcohol-crash problem frequently compare the extent of alcohol involvement among crashed drivers against those who have not crashed. In these studies, a higher proportion of alcohol involvement among the crashed drivers does not necessarily indicate that the crashes were caused by alcohol consumption, but it does raise an inference that alcohol is a cause. Studies also have attempted to differentiate among drinking drivers—both crash- and non-crash-involved—in an attempt to identify those groups that appear to pose an especially great risk to highway safety.

Fatal Crashes

Only four studies in this country (Neilson 1969; Waller et al. 1970; Filkins et al. 1970; Perrine, Waller, and Harris 1971) are known to provide an objective scientific basis for estimating alcohol involvement in fatal highway crashes. All of these studies measured the BACs of fatally injured

drivers who survived less than six hours after the crash. The measurements were taken by coroners and medical examiners for nearly all fatally injured drivers in their respective jurisdictions, thus avoiding possible biases that could be introduced in selecting drivers for BAC measurement.

The results of these studies are shown in Figure 1. It can be seen that 40% to 55% of all the fatally injured drivers tested had BACs of .10% w/v or more. These drivers were too intoxicated to legally drive a motor vehicle in most states. A large percentage of the drivers (29% to 43%) had BACs in the very high range of .15% w/v or greater and 16% to 28% had BACs of .20% w/v or greater. (A 175-pound person would have to consume approximately 6 ounces of 86 proof liquor in an hour to reach a BAC of .10% w/v and 8 ounces in an hour to reach .15% w/v.

Fatally injured drivers in single vehicle crashes tend to show even higher blood alcohol concentrations than fatally injured drivers in general. As shown in Figure 2, by legal standards, 55% to

65% of the fatally injured drivers in such crashes were too intoxicated to drive, and 35% to 54% had BACs greater than .15% w/v.

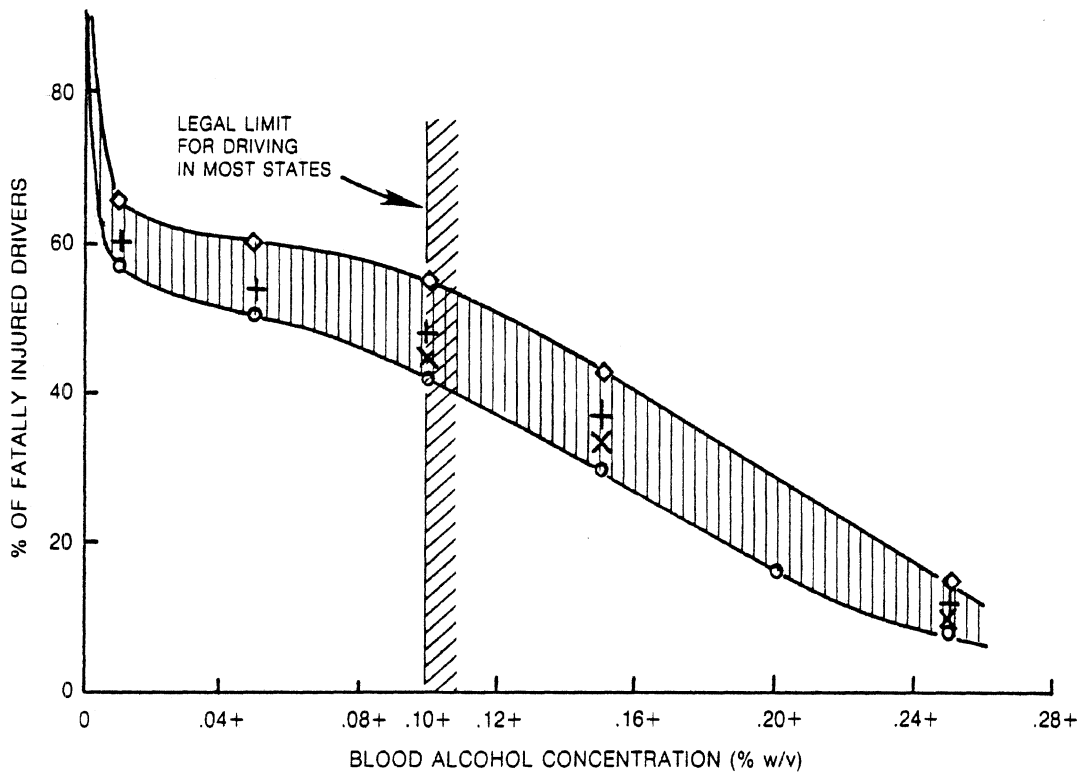
Nonfatal Crashes

Only three North American studies of nonfatal crashes have taken BAC measurements at the scene of the crash:

- The Toronto study in 1951 and 1952 (Lucas et al. 1955),
- The Grand Rapids study in 1962 to 1963 (Borkenstein et al. 1964), and
- The Huntsville/San Diego study in 1974 to 1977 (Farris, Malone, and Lillienfors 1976).

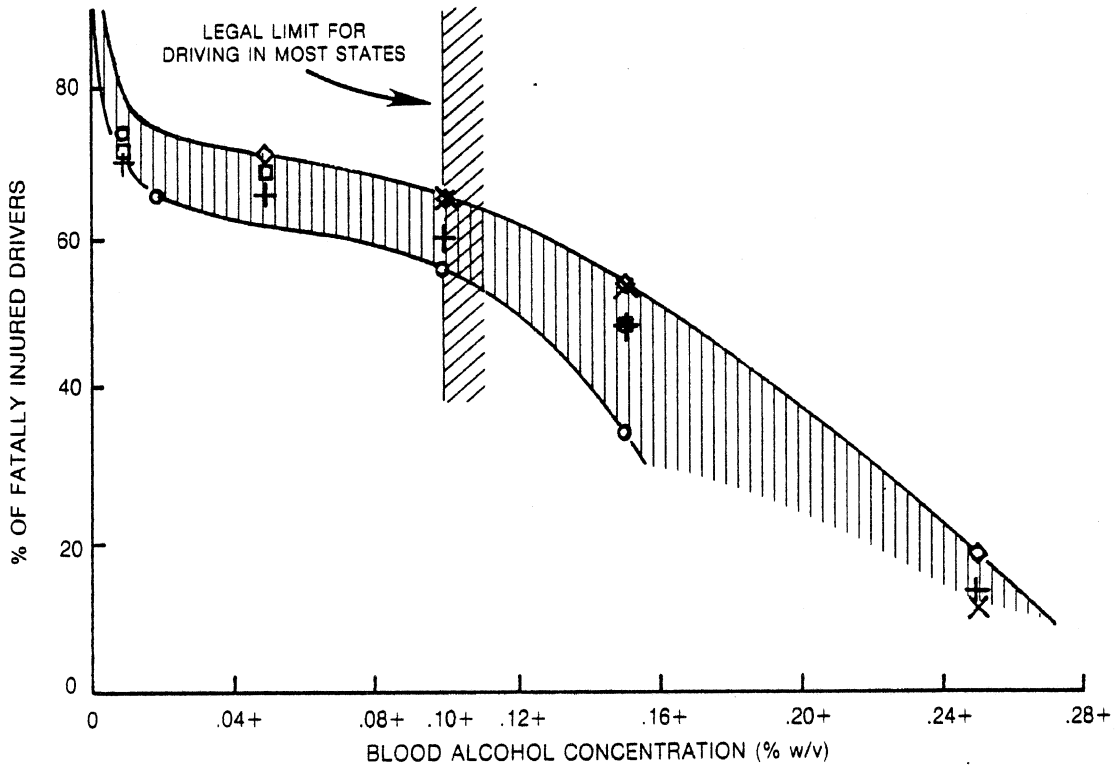
Figure 3 shows the BACs of drivers involved in all types of nonfatal crashes in Toronto and Grand Rapids. The Toronto data indicate about 15% of the crashed drivers had BACs in excess of .10% w/v but the Grand Rapids study showed only about 6% of the crashed drivers at these BACs.

Figure 1
Percentage of Drivers Fatally Injured in Crashes with BACs
Equal to or Greater Than Given Levels



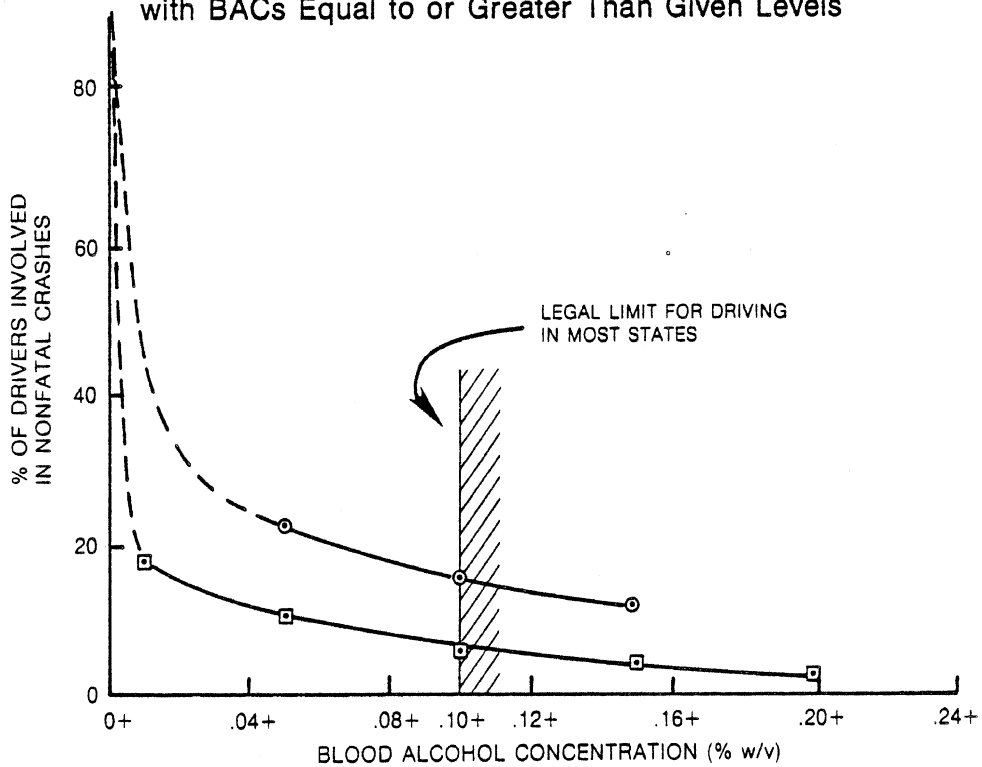
Source: Jones and Joscelyn 1978.

Figure 2
 Percentage of Drivers Fatally Injured in Single Vehicle Crashes
 with BACs Equal to or Greater Than Given Levels



Source: Jones and Joscelyn 1978.

Figure 3
 Percentage of Drivers Involved in Nonfatal Crashes
 with BACs Equal to or Greater Than Given Levels



Source: Jones and Joscelyn 1978.

Even an effective alcohol countermeasure program cannot be expected to have a large effect on the overall crash experience. In the past, the alcohol-crash risk has been overstated and countermeasure programs oversold.

This is possibly due to the fact that the Toronto data were taken in the evening hours when drinking is more frequent while the Grand Rapids data were taken around the clock.

The BACs of drivers in personal injury crashes are shown in Figure 4. The Huntsville data show that about 13% had BACs in excess of .10% w/v, and the Grand Rapids study found about 9% had BACs greater than .10% w/v. Data from San Diego alone had not been presented in the literature, but combined Huntsville/San Diego data indicate a similar distribution of BACs. Figure 5 shows the

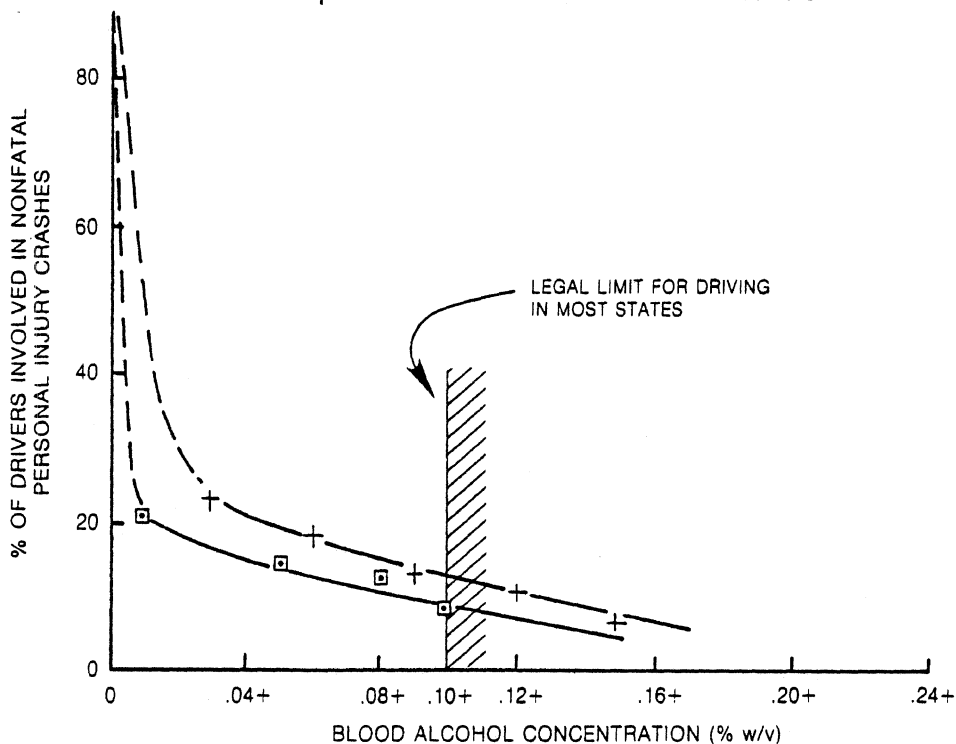
BAC measurements taken in the Grand Rapids study for 4,570 drivers involved in crashes where there were "no indications of injury," that is, property damage only crashes. Only about 5% of these were at or above BACs of .10% w/v.

National Implications

The above cited epidemiologic studies show that some 40% to 55% of all fatally injured drivers had blood alcohol concentrations in excess of .10% w/v. Smaller but still significant fractions of drivers involved in injury crashes (9% to 13%) and property damage crashes (5%) had these high BACs. The national impact of these figures is enormous. If one assumes that the national percentages lie at the midpoints of the ranges stated above, then in 1975 the numbers of crashes involving drivers with BACs of .10% w/v or greater were:

- Fatal crashes: 15,200
- Personal injury crashes: 120,000
- Property damage crashes: 765,000

Figure 4
Percentage of Drivers Involved in Nonfatal, Personal Injury Crashes with BACs Equal to or Greater Than Given Levels



Source: Jones and Joscelyn 1978.

We estimate the societal cost of these crashes to be in the order of \$10 billion. These costs include, for example, lost productivity, welfare and insurance payments, and the use of police and emergency medical services. The losses would be even higher if the thousands of crashes that involved lower but still possibly impairing BACs were counted.

Alcohol impairment clearly increases the traffic crash risk. The risk, however, has often been overstated in the past. A commonly heard fallacy is that half of all traffic crashes are caused by drunk drivers. This is not true. In fact, if all drunk drivers (those with a BAC of .10% w/v or greater) were to be magically removed from the nation's highways, we estimate that over fifty percent of the fatal crashes, eighty-five percent of the personal injury crashes, and ninety-five percent of the property damage crashes would still occur.

This does not suggest that alcohol impairment is an insignificant problem. What it does show is that even an effective alcohol countermeasure program cannot be expected to have a large effect on

the overall crash experience. In the past, the alcohol-crash risk has been overstated and countermeasure programs oversold. This should be avoided in the future. The risk should be accurately stated and risk management expectations reasonably set.

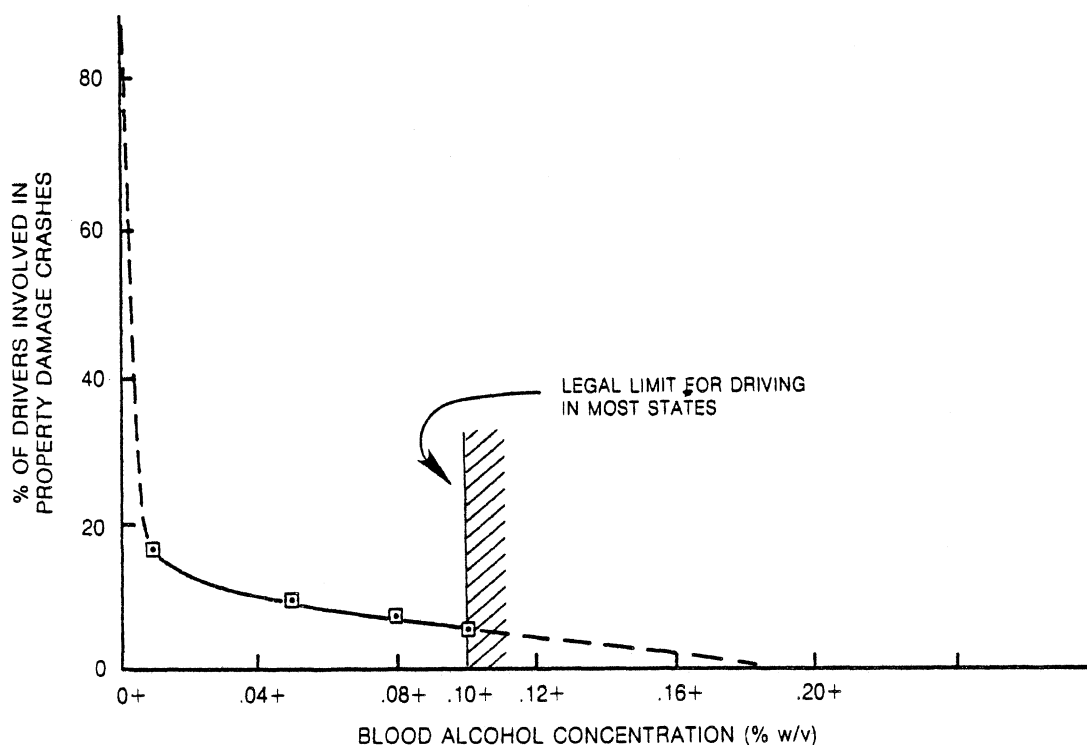
Correlations of the Alcohol-Crash Problem

To deal with the risk caused by drunk drivers, it is important to know who these drivers are. Accordingly, epidemiologic studies also have examined the demographic characteristics, drinking and driving habits, physical and psychological attributes, and attitudes of drinking drivers in an attempt to provide sharper definitions of groups of drinking drivers. Such information is essential for designing countermeasures to deal with the drinking driver problem.

Biographical Variables

Sex has been found to be the strongest differentiator between drivers with alcohol-related

Figure 5
Percentage of Drivers Involved in Nonfatal, No Injury,
Property Damage Crashes with BACs Equal to or Greater Than a Given Level



Source: Jones and Joscelyn 1978.

Figure 6
Age Distributions of Fatally Injured Drivers
with BACs of .10% w/v or Greater (Cumulative)

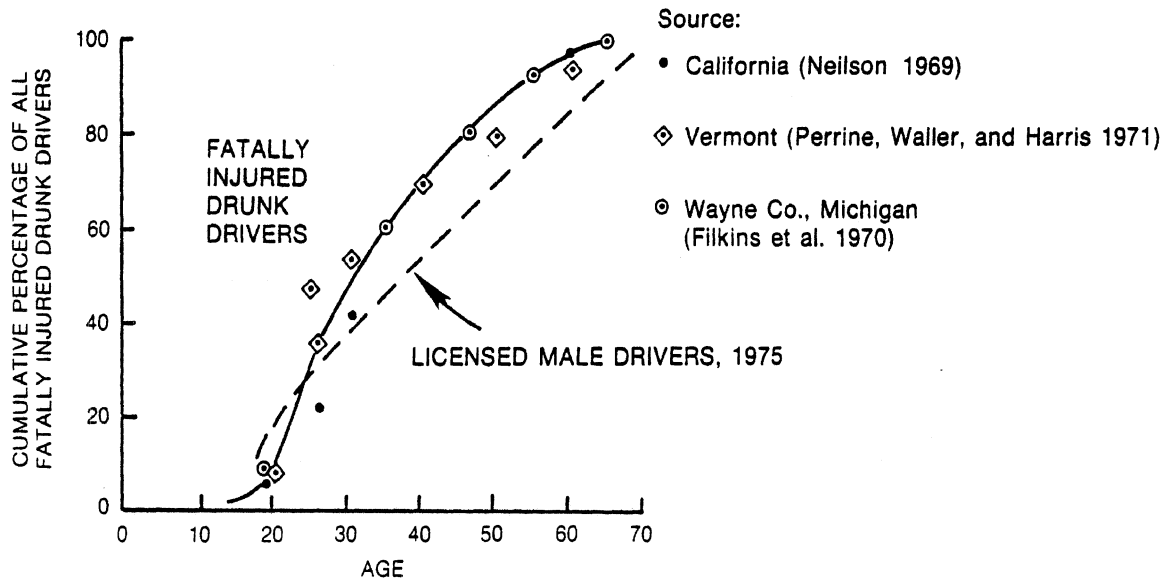


TABLE 7
AGE DISTRIBUTIONS OF FATALLY INJURED DRIVERS WITH
BACs OF .10% w/v AND LICENSED MALE DRIVERS IN 1975

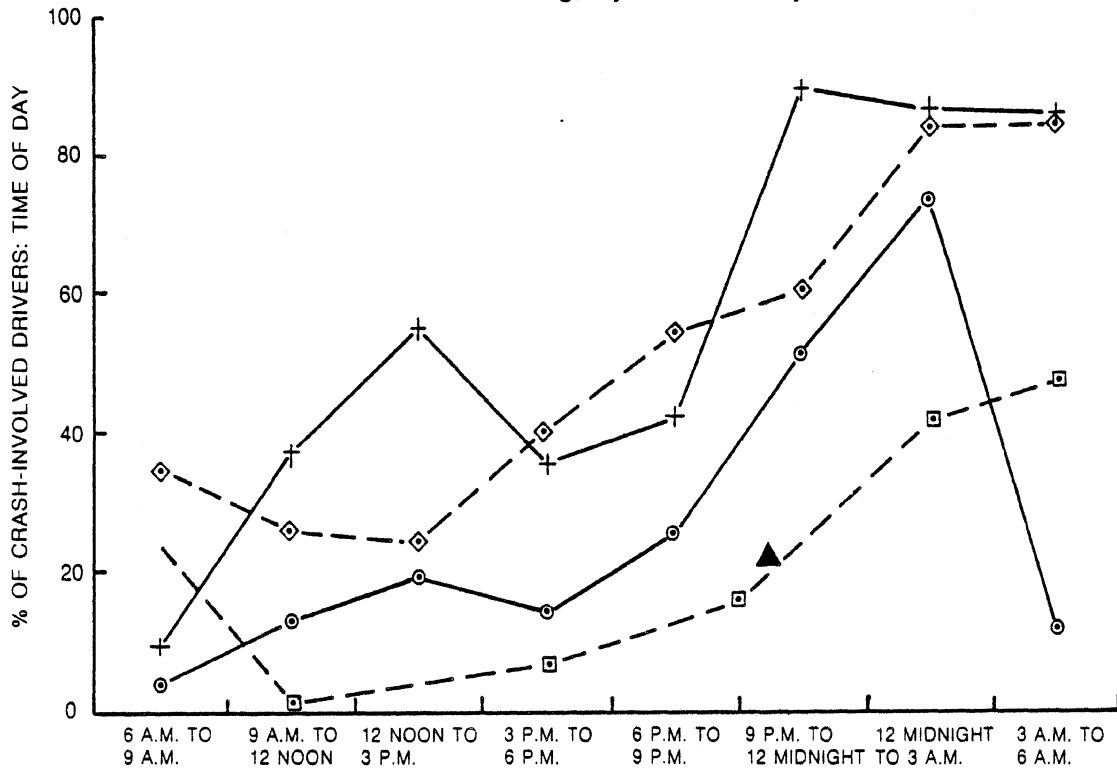
Age	Fatally Injured Drunk Drivers, % ¹	Male Licensed Drivers, % ²
16-19	6.0	9.4
20-24	22.5	13.6
25-29	18.2	12.3
30-34	13.5	9.9
35-39	9.8	8.1
40-44	8.2	7.8
45-54	13.5	16.2
55-64	8.0	12.5
65-up	0.2	10.3
TOTAL	99.9 ³	100.1 ³

¹ Based on data from Perrine, Waller, and Harris (1971); Filkins et al. (1970); and Neilson (1969).

² Based on data from U.S. Department of Commerce (1975); U.S. Department of Transportation (1975b).

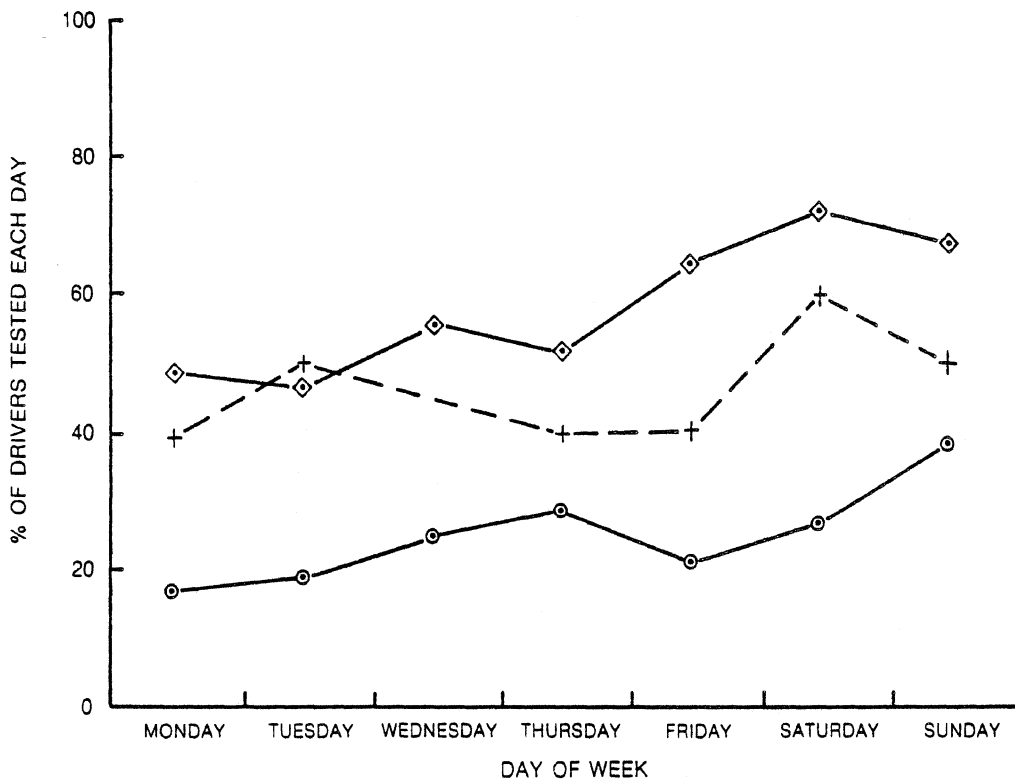
³ The percentages do not total 100% due to rounding.

Figure 8
Percentage of Crash-Involved Drivers Who
Had Been Drinking, by Time of Day



Source: Jones and Joscelyn 1978.

Figure 9
Percentage of Drivers Who Had Been Drinking, by Day of Week



Source: Jones and Joscelyn 1978.

dysfunctions and drivers as a whole. Male drivers appear far more frequently than female drivers in all kinds of crashes (National Safety Council 1979). Males comprise even higher percentages of drivers in the more serious crashes. Similarly, while males account for the majority of those using the roads, males make up an even larger fraction of high BAC drivers (that is, over .10% w/v). Not surprisingly, the predominantly male nature of drunk driving is reflected in the arrest statistics for drunk driving, which typically show that ninety-five percent of those arrested for drunk driving are male.

With respect to age, both the youngest and the oldest drivers have been found less frequently than other drivers in the drunk driver population. Also, the youngest and oldest crash-involved drivers have consistently had lower BACs than other crash-involved drivers; however, the most reliable studies of the alcohol involvement in fatal crashes provide remarkably consistent profiles of the age distribution of drunk drivers who were killed in crashes (see Figure 6). When the distribution is compared with that of all male licensed drivers—about 90% of all fatally injured drunk drivers are male—the overrepresentation of drivers aged twenty to forty-five years in the crash population becomes apparent (Table 7). It can also be seen that the median age of fatally injured drunk drivers is about thirty years compared to thirty-seven for all fatally injured male drivers.

Studies of drivers' marital status have shown that married persons comprise the largest percentage of drivers who have crashed and of drinking drivers using the road (see, for example,

Persons arrested for drunk driving are seldom female, very young, or very old. They are usually arrested during weekends and at night and are often engaged in low status occupations.

Borkenstein et al. 1964). However, as a group, divorced and separated persons seem to combine drinking and driving more frequently and may have a higher crash risk than married persons. Unfortunately, the effects of marital status on impaired driving are often confounded in the literature with

other effects, such as age, so that it is difficult to make unequivocal statements about the effects of this variable.

Less clear relationships have been found between other variables and drinking driving. There are indications that persons of lower occupational levels are overrepresented among drinking drivers, but these findings are not conclusive because of the confounding effects of other variables such as age and sex. Increased alcohol involvement among nonwhites has been explained in one study as a socio-economic rather than a racial effect. Persons in low-income groups were especially overrepresented among nighttime drivers in a nationwide survey, particularly at very high BACs where they outnumbered other drivers by a factor of three to one. Less educated persons were found more frequently among drinking drivers in some older studies, but more recent studies show less of an educational effect except at high BACs. However, there is no convincing evidence that either occupational level, race, income, or education is strongly related to alcohol crash risk.

Driving Variables

Among the many driving variables that have been studied, time of day has shown some of the strongest relationships to drinking driving patterns. As might be expected, drinking driving is primarily a nighttime phenomenon (see Figure 8). Drinking drivers are found two to four times as often in nighttime crashes as in daytime crashes. The same trend occurs among the nighttime population as a whole, particularly with the high BACs. With respect to day of the week, alcohol-related crashes and drinking drivers are also more frequent on weekends than on weekdays, although this effect is not nearly as great as it is for time of day (see Figure 9).

Conflicting results have been obtained with respect to the relationships between annual mileage driven and drinking driving. There are indications that persons who drive relatively infrequently may be overrepresented among both drinking drivers involved in crashes and drinking drivers not involved in crashes, but these results are not conclusive. The relative risk of a crash after drinking may also be higher with a very low mileage driver. The origin of the trip that involved the illegal drinking driver is most frequently a bar or another per-

son's home.

Research suggests that drinking drivers have had a slightly higher number of previous crashes and substantially more enforcement actions against them than other drivers. Drinking drivers have been found to have on the order of fifty percent more prior contacts with traffic law enforcement agencies than other drivers. Particularly, persons arrested for drunk driving generally have more prior driving convictions than other drivers and perhaps more prior crashes as well. The BACs of persons arrested for drunk driving are nearly always at an illegally high level (i.e., in excess of .10% w/v). These persons are seldom female, very young, or very old. They are usually arrested during weekends and at night and are often engaged in low status occupations.

Drinking Variables

Among those variables that are classified as drinking variables, the relationships that have been found with respect to drinking frequency and quantity are in many ways most enlightening. As might be expected, crashed drivers seem generally more likely to have a higher BAC than non-crashed drivers, regardless of drinking frequency. However, the ratio of crashed drivers to non-crashed drivers tends to decrease with increasing drinking frequency, indicating that more experienced drinkers are somehow better able to cope with the effects of alcohol on driving.

One study that investigated the effects of frequency and quantity on drinking drivers (Perrine, Waller, and Harris 1971) found a higher percentage of males among drivers who reported a high quantity frequency index (QFI). Also, many teenagers were found to have high QFIs but QFI decreased with a person's age. There were indications that crash involved drivers were slightly heavier drinkers than other drivers. Drivers in alcohol-related crashes were heavier drinkers than drivers in non-alcohol-related crashes.

Studies have also investigated the type of beverage preferred by drinking drivers and have found that beer is preferred by about two to one over other beverages by drinking drivers. An especially high preference for beer has been expressed by drivers with high BACs and drivers who report they are heavy drinkers.

The place of drinking most frequently reported by drinking drivers was their own home (two out of

three). About twenty-five percent said they usually drink at public establishments or parties. The higher BACs have most frequently been found among drivers who said they drank in public establishments.

To the extent that the number of nonpedestrian fatalities involving drunk drivers is a measure of the alcohol-crash problem, the problem will remain about the same with respect to the total crash problem in 1985. However, because of increased traffic volume, plus an anticipated mix of very large and very small vehicles, a fairly large increase in the total crash problem is projected for 1985.

Much attention has been given in the literature to the drinking driving habits of alcoholics and problem drinkers, although many studies do not provide precise definitions of the latter term. Studies do provide evidence that persons with severe drinking problems are highly overrepresented among fatally injured drivers who have BACs greater than .10% w/v. One study found problem drinking to be highly associated with drivers found to be responsible for the crashes in which they were killed. More than half of all arrested drinking drivers tested in three Alcohol Safety Action Projects were found to be problem drinkers. Other research indicates that alcoholics in particular have much higher crash rates than the driving population as a whole, perhaps even twice as high. Alcoholics may also engage in drinking driving more frequently than other drinking drivers and at higher BACs.

Personality and Stress Variables

Studies of personality and stress variables that may be related to drinking and driving have not been conclusive and offer little reliable information for generalizing. Factors that have been found to be associated with drinking driving include alienation and hostility (especially among young men); low personal efficacy; an inordinate amount of tension, depression, and fatigue; and risk taking.

Alcohol, Highway Safety, and the Future

In 1977 we attempted to project the alcohol-crash problem to the mid-1980s by projecting the correlates (Jones 1977). We have reexamined the assumptions made in that study in the light of more recently published data and found that the assumptions are still reasonable. Specifically we believe that the following expected changes in alcohol-crash correlates are relevant over the next five years:

- Larger percentage of female drivers,
- Smaller percentage of drivers under 20 years of age,
- Smaller percentage of drivers over 65 years of age,
- Larger percentage of drivers in the 20- to 65-year-old age group,
- Increased per capita consumption of alcohol,
- A heterogeneous mixture of large and small vehicles with a predominance of small cars,
- Slight increase in "safety features" in both vehicles and highways, and
- More vehicle miles traveled.

Factors that could obviate or reduce the effects of these expected changes include:

- Large decrease in availability of fuel that reduces vehicle miles traveled,
- Widespread adoption of passive restraints in cars,
- Major changes in the economic climate (for example, a depression or runaway inflation),
- Technical breakthroughs in automobile and highway design,
- Prohibition or large-scale restrictions on alcohol availability, and
- Widespread usage of drugs other than alcohol.

The net effect of these factors on the alcohol-crash problem as presently understood will be to increase the number of fatalities by several

hundred per year. This amounts to about one percent of the total number of non-pedestrian fatalities that could be expected in the mid-1980s. We view such a small change as insignificant in the light of the uncertainties in the data and conclude that, to the extent that the number of non-pedestrian fatalities involving drunk drivers is a measure of the alcohol-crash problem, the problem will remain about the same with respect to the total crash problem in 1985. However, because of increased traffic volume, plus an anticipated mix of very large and very small vehicles, a fairly large increase in the total crash problem is projected for 1985; thus, the absolute magnitude of the alcohol-crash problem should increase substantially by that time. This translates into 9,000 more fatalities, 120,000 more serious injuries, and 127,000 more property damage crashes than occurred in 1975.

A number of driver characteristics have been found to be associated with a higher than average involvement in alcohol-related fatal crashes. These include male sex, age of 20 to 60 years, heavy drinking and severe drinking problems, preference for beer over other alcoholic beverages, nighttime and weekend driving habits, and history of prior arrests for drunk driving. Driver characteristics associated with a higher than average crash risk after drinking include female sex, youth, old age, and light drinking habits.

As we look toward the next decade we see the alcohol-crash problem continuing at about its present level in comparison to highway crashes as a whole. The absolute number of the more serious alcohol-related crashes will likely increase, barring unexpected shifts in trends of key attributes of the Highway Transportation System.

Strategies and Tactics for Reducing the Alcohol-Crash Risk

Past strategies and tactics that have been used to reduce the alcohol-crash risk are conveniently classified as:

- legal,
- health,
- public information and education (PI&E),
- technological, and
- systems.

Each of these five approaches is discussed in this section.

The Legal Approach

Legal approaches are based on a set of official rules (laws) that define and prohibit drinking driving behaviors believed to present unacceptably high risk to society. Failure by the driver to comply with these rules results in sanctions (for example, fines, jail sentences, and loss of driving privileges) that are believed to discourage, or deter, persons from engaging in the prohibited behavior. Some laws are related less directly to drinking driving, for example, so-called implied consent laws that require drivers either to submit to a chemical test for BAC when asked to do so after being arrested for drunk driving, or receive a license suspension. The legal approach also supports the application of "sanctions" by other less formal systems, for example, increased insurance rates after a conviction for drunk driving and the subsequent availability of conviction records to insurance carriers

The legal approach has been society's traditional response to the alcohol-crash problem in the United States.

for adjusting the insurance rates of the drivers.

The legal approach as sketched out above (see Jones and Joscelyn 1976 for a more complete discussion) has been society's traditional response to the alcohol-crash problem in the United States and in many other countries as well. Few applications have been carefully evaluated so little is known about its effects on crashes. Only one such evaluation, in Great Britain, showed clear-cut

results in reducing alcohol crash losses. The evaluation concerned a program of law changes known as the British Road Safety Act of 1967. The new British legislation set a lower legal limit for intoxication (.08% w/v BAC) and provided that driving with an illegally high BAC—whether or not driving impairment occurred—was an offense. The Act also expanded the powers of police to demand that drivers take a breath test after crashes and law

The concept of deterrence is the basis for the legal approach. Its premise is that behavior can be prevented by the threat of punishment.

violations as well as on suspicion of impairment. An extensive public information and education campaign accompanied passage of the Act and its enforcement. This program was evaluated post hoc by Ross (1973) and was found to have achieved a three-year decrease in the rate of "accident casualties." Another foreign program growing out of Dutch legislation setting the legal limit of intoxication at .05% w/v BAC may have had a similar temporary effect, but the final findings are not yet complete.

In the United States, the National Highway Traffic Safety Administration (NHTSA) sponsored a series of Alcohol Safety Action Projects (ASAPs) that employed a combination of legal, health/legal, and other approaches. Early evaluations by NHTSA reported that the ASAP program was having a positive effect on the alcohol-crash problem across all sites, but these findings were disputed. The NHTSA evaluators themselves found little to support the hypothesis that the legal component of their program was responsible for the effects they reported. A more recent NHTSA evaluation of ASAP (U.S. Department of Transportation 1979), not yet critiqued by the highway safety community, reports positive effects for twelve out of thirty-five ASAP sites and attributed at least some of the effect to the legal component. NHTSA's field experiment in Stockton, California suggests that its greatly increased enforcement activity has decreased the percentage of drunk drivers on the roads but produced no significant decrease in alcohol-related collisions. Assessments of other

legal approaches in the U.S. and abroad have either shown no effect in reducing crash losses or have been inconclusive.

As noted above, the concept of deterrence is the basis for the legal approach. Its premise is that behavior can be prevented by the threat of punishment. Deterrence theory suggests that deterrence can be accomplished when members of the target population believe that the threat (1) is applicable to them personally, (2) can and will be enforced and (3) would cause them sufficient unpleasantness to outweigh any positive benefits derived from drunk driving.

It seems likely that the failure of legal approaches to maintain long-term effects on the drinking-driving problem can be attributed to a failure to meet one or more of these deterrence requirements. For example, the British Road Safety Act concentrated on creating a perception of the severe deterrent threat but did not maintain the public information and education effort and did not back up the perceived threat with effective

Most applications of the health approach to the drinking driving problem have been conducted in concert with legal approaches and thus constitute what has come to be called a health/legal approach.

enforcement and sanctioning action. Thus long-term deterrence was not achieved because the proclaimed threat did not remain credible. Other applications also have been unsuccessful over a long period of time because their enforcement activities were not sufficiently publicized to reach drivers who were not apprehended for drunk driving. There is now evidence from studies conducted in California that imposition of severe sanctions can have a deterrent effect on the sanctioned driver. Three quasi-experimental studies conducted by the California Department of Motor Vehicles provided evidence that license action is the most effective available means of reducing recidivism (subsequent impaired driving and traffic crashes). The first study (Hagen 1978) found license suspension to have a deterrent effect that lasted beyond the term of suspension. The second

study (Hagen, Williams, and McConnell 1979) found that treatment programs demonstrated no advantages over license action. The most recent California study (Hagen, McConnell, and Williams 1980) compared recidivism records of impaired driving offenders and found that multiple offenders who suffered license suspensions had better recidivism rates than offenders who received no suspension. This suggests that such a deterrent threat could be extended to the larger driver population through effective public information and education measures.

The Health Approach

Health approaches are aimed at the underlying drinking problems that often exist among individuals who drive with high BACs. Various treatments and therapies (such as Alcoholics Anonymous) are applied to such individuals in an effort to induce more moderate drinking habits or to eliminate drinking entirely. Rehabilitation and education programs (such as drunk drivers' schools) for all types of drinking drivers are also included in this category.

Most applications of the health approach to the drinking driving problem have been conducted in concert with legal approaches and thus constitute what has come to be called a health/legal approach. In this combined approach, the strategy is to use the resources and methods of both the traffic law system and the public health system to reduce the incidence of drinking driving among an identified target group. A basic tenet is that neither the traffic law system alone with the punishments,

Treatment programs tend to have a long-term rather than a short-term effect on both alcohol consumption and behavioral and social impairment of persons with drinking problems.

nor the public health system alone with its treatments, can adequately deal with the problem. The combined resources of both systems are needed to bring about the desired behavioral changes through the application of individually tailored mixtures of punishment and treatment. Thus, the

health/legal system must apprehend and arrange for the punishment and treatment of drinking drivers in the target population.

Under NHTSA sponsorship, we recently completed a nationwide study of health/legal systems (Jones, Joscelyn, and McNair 1979). We found that practically every conceivable means of identifying, referring, and treating drunk drivers was being practiced somewhere. Unfortunately we found no evidence that any of the approaches or their specific applications had reduced alcohol-related crashes or drunk driving. Some of this lack of evidence of highway safety impact can be attributed to the lack of rigorous evaluations of these programs. However, some programs have been evaluated and found to have no effect, or even a negative effect on crashes (Nichols et al. 1978; Preusser, Ulmer, and Adams 1976).

Two possible reasons are suggested for this difficulty in showing highway safety benefits. First, the health component of the health/legal approach requires that for an individual to be treated he or she must first be brought into the system after having been apprehended in the act of driving drunk. Although the exact probability of apprehension for drunk driving in a given jurisdiction is not known, it has been estimated to be quite low, of the order of 1 chance in 200 to 1 chance in 2000 drunk driving trips. This means that an individual who drove drunk four times a week could expect to continue doing so for about one to ten years before being caught. Once apprehended, the driver then has to be properly processed and sent to an "appropriate" treatment.

The difficulty of finding and then providing this appropriate treatment is the second reason why it is difficult to reduce alcohol-related crashes through the health/legal approach. A recent report to the U.S. Congress on alcohol and health noted:

Few differences in effectiveness among treatment settings, types and direction have been identified. The patients' characteristics and motivation may be the essential factors in the recovery process. (Noble 1978, p. 76)

In this case, effectiveness was stated in terms of alcohol consumption, behavioral effect, and social adjustment. While Noble's conclusion applied only to alcoholics, similar difficulties have been noted in programs dealing with individuals with less severe drinking problems. Studies also suggest that treat-

ment programs tend to have a long-term rather than a short-term effect on both alcohol consumption and behavioral and social impairment of persons with drinking problems. This makes program evaluation more difficult and the identification of the appropriate treatment more tenuous.

The Public Information and Education Approach

Public information and education (PI&E) approaches attempt to reduce the incidence of drinking driving by campaigns informing and educating various population groups about the nature of the problem. Such programs address drinking drivers directly by attempting to get them to refrain from drinking driving in the future or indirectly by attempting to enlist support of other persons as well as actions against drinking driving. A television commercial designed to motivate persons to drive an intoxicated individual home from a party is an example of the indirect approach. PI&E approaches are most commonly used in combination with other approaches (for example, legal), both to inform the public about the actions that will be undertaken to control drunk driving and to create a climate of public support for the alcohol safety program.

Content of drinking driving laws has been the focus for most campaigns associated with the introduction of new drinking driving legislation. The British campaign of 1967 was designed to heighten awareness of the public to their rights and obligations under the new legislation. The establishment of per se BAC limits that made evidence of driving impairment unnecessary; the procedures for the apprehension, arrest and charging of drinking driving; and the penalties associated with convictions were the major variables about which information was disseminated in this campaign.

Many other information campaigns in the United States, Canada, England, and Australia have been conducted when it was determined that although drinking driving laws were not new, the public was poorly informed about the dangers of drinking and driving and entertained attitudes not conducive to safe driving behavior, or engaged in behavior that contributed to the dangers of drinking and driving. Attempts have also been made to change the social value attached to driving after consuming

alcohol. Both the 1967 British and a similar 1969 Canadian campaign also measured public attitudes about the adequacy of the new legislation to prevent or to reduce alcohol-related accidents.

In the United States the ASAPs sponsored by NHTSA have conducted public information campaigns since 1971. They attempted to develop an

There is evidence that PI&E campaigns can increase the public's knowledge about drinking driving laws and its understanding of the effect alcohol has on the body and driving skills. There is little evidence to show that PI&E campaigns themselves change either attitudes or behavior.

awareness among the public of the dangers and consequences of drinking and driving. They tried to personalize the problem of identifying drunk drivers as friends, relatives, and acquaintances to counteract the tendency to see the drinking driver as a deviant. They also attempted to stimulate social and peer group concern and to identify specific actions each could take to cope with drinking drivers.

Most specialists believe that well designed and executed PI&E campaigns can be successful in transferring information but cannot in themselves bring about behavioral changes. Any alterations of individual drinking driving habits that result from such campaigns are seen as an unexpected side effect. Only in cases where the campaigns are combined with other types of countermeasures have any behavioral changes been noted. The 1967 British case is a significant example of a campaign whose impact went beyond the gain of knowledge.

Inadequate designs for evaluation have made it difficult to determine the exact nature and extent of the impact of most highway safety PI&E campaigns. Pretesting and posttesting have been done for almost all campaigns, but very few of them have used control groups. Even the British program did not use a control group.

Media campaigns in Edmonton and Ontario used control groups that, in each case, were cities

selected to match treatment cities in terms of size and relative isolation from the media of the treatment cities. Both of these campaigns were successful in transferring factual information about the contents of drinking driving laws. Similar successes were reported in a media campaign in Sydney, Australia.

In the case of the British Road Safety Act of 1967, results of public opinion surveys indicated an increase in knowledge about the BAC limit, the ability of the breath test to determine alcohol consumption, that refusal to take a breath test could lead to an arrest, and loss of license as a consequence of refusing to take a breath test.

In the United States, the ASAP evaluation concluded that "in each area of concentration substantially more sites with public information activities achieved positive results than sites without an effort" (U.S. Department of Transportation 1975a, p.1). It should be noted that all of the ASAPs conducted other types of countermeasures concurrently with public information and education campaigns, and that most used only a pretesting and posttesting in their evaluation of campaign effectiveness. However, the pretest and posttest surveys did show that sites with public information and education campaigns indicated greater gains in knowledge than sites without such campaigns.

In sum, there is evidence that PI&E campaigns can increase the public's knowledge about drinking driving laws and its understanding of the effect alcohol has on the body and driving skills. There is little evidence to show that PI&E campaigns themselves change either attitudes or behavior.

In the few cases in which behavioral change occurred, PI&E campaigns were conducted in conjunction with other countermeasures and in most cases the impact of the PI&E campaign could not be isolated from the impact of other countermeasures. Thus, research does not show that such campaigns in general are ineffective but merely indicates that they have not been successful in reducing crashes when used alone. There is evidence that they have been effective in supporting other alcohol safety approaches, particularly the legal approach.

The Technological Approach

Technological approaches use modern technology to interrupt the sequence of events leading

to drinking driving. A wide range of technologies has been suggested for such applications, from pharmaceuticals designed to speed up the sobering process to devices for warning drivers about the presence of a car with a drunk driver. In the past, specific applications of technology to the drinking driver problem have been limited almost entirely to devices that support the legal and health approaches described above. No purely or even largely technological approach has yet been tried, although several have been proposed and studied.

It is interesting that, although evidential breath testers have been used for nearly thirty years, no formal evaluation of their effectiveness in supporting legal and health/legal objectives has been made.

In this section we discuss the type of technology that had the greatest impact on the alcohol-crash problem, breath alcohol analysis. Some other possible but untried applications of technology are described briefly.

The purpose of breath-alcohol testing for traffic safety purposes has been to calculate BAC from breath specimens. The earliest such device used extensively in the United States (after passage of the 1939 law in Indiana admitting chemical test results as evidence) was the Hargar Drunkometer. Since that time, a wide variety of breath testing instruments have been developed, one of the most successful and widely used being the Breathalyzer® developed by Robert F. Borkenstein.

Current breath testing devices have been classified as to their application and support of efforts to control the drinking driver. Six basic classes of instrumentation were defined in one study (Moulden and Voas 1975):

- screening breath testers,
- evidential breath testers,
- roadside collection devices,
- passive breath testers,
- educational testers, and
- alcohol safety interlock systems.

A more useful classification can be developed based on the involvement of the individual to be

tested. Active breath test devices require the driver to provide a sample of deep lung breath for analysis. Passive devices capture normally expelled breath and do not require the cooperation of the driver. The first three classes defined above (screening breath testers, evidential breath testers, and roadside collection devices) are all active devices. The first two devices provide a direct reading. The third class, roadside collection devices, are used to collect breath samples for later analysis by evidential breath testing.

The use of an active breath test device constitutes what is defined by the law as a search. Thus, active tests can be administered only as permitted by the U.S. Constitution and applicable statutory law. In general, an active test cannot be demanded of a driver unless an officer has probable cause to arrest the driver for an alcohol-impaired driving offense. This is a constitutional constraint. Most states, by statute, require an actual arrest before a test can be required under the state's implied consent law.

Active test devices produce either a qualitative indication of intoxication (in which case it is a screening device) or a quantitative reading of BAC that is accurate enough to be used as evidence of intoxication in which case it is an evidential test device. It is interesting that, although evidential breath testers have been used for nearly thirty years, no formal evaluation of their effectiveness in supporting legal and health/legal objectives has been made. They are now such an integral part of both approaches that it seems doubtful that any meaningful evaluation could now be performed.

As more accurate screening devices become commercially available and as quantitative testers have become more portable, efforts have been made to increase roadside testing of drivers. The use of roadside tests has resulted in increased arrests. Also, the average BAC of arrested drivers tended to be lower in some field experiments using the roadside testing devices. The use of chemical tests at the roadside is likely to result in more accurate evidence in cases of impaired driving; more efficient law enforcement operations; and less inconvenience for the motorist.

Laws intended to permit roadside testing prior to arrest have been passed in several states. Such laws are advocated by NHTSA to assist an officer "to establish probable cause for an arrest." While the objective of facilitating roadside testing is

worthwhile, preliminary breath test laws that purport to allow an officer to require a test when probable cause to arrest does not exist are not constitutional. The approach advocated by NHTSA should not be followed. A more direct approach, and a constitutional one, is to amend existing implied consent laws to provide for roadside testing when probable cause to arrest exists. Most such laws now require a formal arrest, a time-consuming process that is costly for law enforcement personnel and inconvenient for the motorist. The constitutional requirement for a search (which category includes the active test) is that evidence sufficient to arrest exist. Recent court decisions have held that a formal arrest is not required to search for evidence that is likely to disappear, like that of alcohol presence that changes over time. Thus probable cause to arrest a driver for drunk driving is still a constitutional requirement of testing, whereas a formal arrest is not.

A more detailed discussion of these issues can be found in a report recently prepared for NHTSA (Ruschmann et al. 1980). One of the papers in this series—*Alcohol, Drugs, and Traffic Law*—specifically addresses legal issues and makes recommendations for legislative action.

Analysis of the various technology concepts outlined above indicates substantial problems in using any of them (other than the active test devices) in operational programs to reduce the incidence of alcohol-related crashes.

The remaining breath testers have not yet been used operationally. Passive breath testing devices (now called noncooperative breath testers) might help overcome the objection that prearrest breath testing constitutes an illegal search or seizure. They would make a qualitative determination of breath alcohol by "sniffing" the air around the driver and would not require the driver's cooperation. Educational testers (now called self-testers) would be used by drivers to determine if their BACs had reached levels indicating impairment. They could be low-cost, individual, disposable devices that could be dis-

tributed by liquor stores, schools, and the like, or reusable breath testers that could be installed in places such as bars and restaurants.

The drunk driver warning system (DDWS) concept has superseded the alcohol safety interlock system at NHTSA. The DDWS concept would allow an impaired driver to start the vehicle but would cause the vehicle's emergency lights to flash at speeds of less than 10 mph and the horn to sound intermittently at speeds above 10 mph. A possible use of the DDWS would be to install it on cars of convicted drunk drivers as a condition of probation.

Again, neither the noncooperative breath tester, self-tester, nor the DDWS has yet been demonstrated to be feasible for use in drinking driving control programs. Tests with the self-tester (Oates 1978; Sharp and Perry 1978) suggest limited usefulness in the applications tested.

A variety of other technology-oriented concepts have been suggested for dealing with the alcohol-crash problem (Voas 1970). One device would monitor driving performance continuously for clues that would betray alcohol impairment. When the device indicated unacceptably high impairment, a warning signal would be given or a speed governor would be activated. A similar system has been designed to prevent truck drivers from falling asleep. It has also been suggested that a mechanical or electronic device be built to restrict convicted drunk drivers to driving only during certain specified hours. The device could use a light sensor or timing mechanism either to activate an interlock or to give a warning signal if the vehicle has been driven during restricted (for example, nighttime) hours. Alternatively, an operating time recorder could be used to indicate if the vehicle had been driven during restricted hours.

An application of pharmacological technology has been studied as a means to reducing the impairing effects of alcohol. Several drugs for blocking the effects of alcohol on the nervous system have been tested in search for such a "sobering pill" (Noble 1974). Research is continuing in the area, but no practical drug for cancelling the effects of alcohol has yet been discovered.

Analysis of the various technology concepts outlined above indicates substantial problems in using any of them (other than the active test devices) in operational programs to reduce the incidence of alcohol-related crashes. In some cases

(for example, the sobering pill) feasibility has not been demonstrated. The drinking driver may decide not to use the self-tester, and the cost of self-testers may be too high for practical use. All of these devices would run the risk of being defeated by ingenious drivers and could present legal problems.

The Systems Approach

Most past and proposed programs for dealing with the drinking driver employ two or more of the above four approaches—legal, health, PI&E, and technological—simultaneously. For example, the health/legal approach is a combination of the health and legal approaches. Programs that methodically employ several approaches have been called systems approaches in the literature.

The term “systems approach” appears to have been introduced in the early 1950s to describe techniques for managing large and complex aerospace projects (Jones and Joscelyn 1976). One of the first documented applications of the systems approach to the alcohol crash problem was the Joscelyn and Jones (1971) analysis of the drinking driver control system.

In 1969, the National Highway Safety Bureau (later the National Highway Traffic Safety Administration) of the U.S. Department of Transportation announced the nationwide Alcohol Safety Action Project (ASAP), many of whose ac-

No other alcohol-safety program of comparable scope, depth, and size has attempted the systems approach to the same degree as ASAP.

tivities have been reported earlier in this document. The program provided financial assistance to and coordinated the efforts of at first nine and ultimately thirty-five ASAPs around the country. From the beginning it advocated the systems approach, declaring that “in planning and managing an ASAP the project director will need to use the systems approach in order to properly integrate all the complex aspects involved” (McKnight, Adams, and Personeus 1971).

No other alcohol-safety program of comparable

scope, depth, and size has attempted the systems approach to the same degree as ASAP, although some jurisdictions have applied and continued to apply some of its concepts of their own. For this reason the remaining discussion of the systems approach to drinking driver control will be limited to ASAP, with particular emphasis on what is most relevant to the systems concept rather than on the individual countermeasures discussed previously in this paper to illustrate other approaches.

ASAP was heavily oriented toward the problem-drinking driver. Early ASAP publications claimed

ASAP used a combination of the legal, health, public information and education, and technological approaches in its attack on alcohol-crash risk.

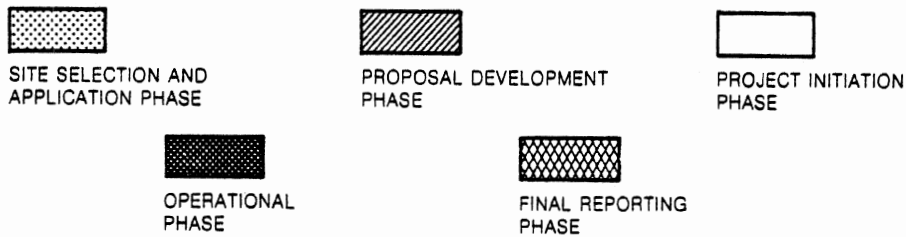
the problem-drinking driver was responsible for two-thirds of the alcohol-related traffic fatalities in the United States and thirty-four percent of all traffic fatalities. (We note that facts do not support this claim.) ASAP also placed emphasis on drinking drivers who drive at night and on weekends, drawing upon research that has indicated an increased prevalence of alcohol impaired drivers using the roads and involved in crashes at such times.

The ultimate goal of the ASAP was to “demonstrate and evaluate the feasibility, methodology and impact of comprehensive multifaceted countermeasure programs designed to reduce the incidence of alcohol as a causal factor in motor vehicle crashes” (Crittenden 1970).

Individual ASAP projects were conducted at the local level emphasizing improved law enforcement, traffic court procedures, public information, and special efforts to counsel and assist drivers. The local activities were designed to be complemented by state-level efforts in driver licensing, motor vehicle registration, traffic records, and legislation. Some \$88 million was allocated directly to the ASAP program, but 37% of this was used in the management and evaluation of the projects (U.S. Department of Transportation 1979). Additional funds far in excess of the \$88 million quoted by NHTSA were expended in the form of local “match” and other NHTSA research and development activities conducted explicitly to sup-

Figure 10
Operational Phasing of the Alcohol Safety Action Projects

INITIAL YEAR OF FUNDING	NUMBER OF PROJECTS	CALENDAR YEAR							
		1969	1970	1971	1972	1973	1974	1975	
FY 70	9	MAR				NOTE 1		NOTE 2	
		NOV							NOTE 2
FY 71	20								NOTE 2
FY 72	6			FEB					NOTE 2
				AUG					

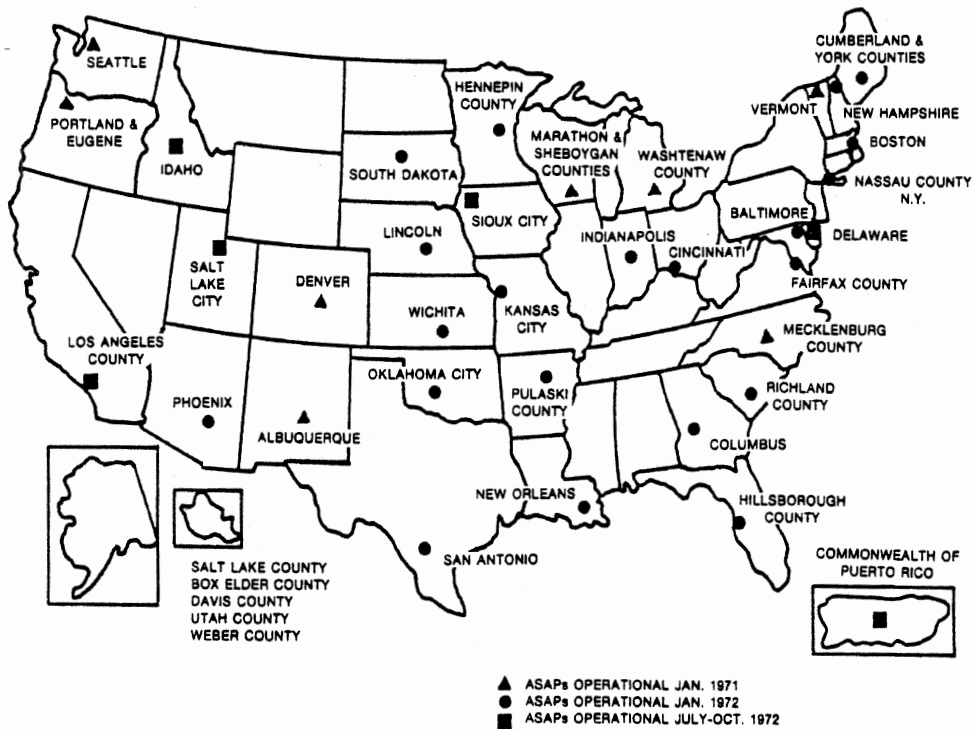


NOTE 1: OPERATIONAL PERIOD VARIES IN ASAPs

NOTE 2: REPORTING PERIOD VARIES IN ASAPs

Source: U.S. Department of Transportation 1974

Figure 11
Locations of Alcohol Safety Action Projects



Source: U.S. Department of Transportation 1974

port the ASAP effort. A more reasonable estimate of ASAP's total cost would be in excess of \$200 million.

Each project had an operational lifetime of at least three years (see Figure 10). The first group of nine ASAPs began operating in 1971 and twenty-six additional ASAPs initiated operations in 1972. The locations were widely distributed around the United States and included one site in Puerto Rico (see Figure 11).

ASAP used a combination of the legal, health, public information and education, and technological approaches in its attack on the alcohol-crash risk. Eventually five separate categories of countermeasure activity evolved:

- enforcement,
- judicial and legislative,
- presentence investigation and probation,
- rehabilitation, and
- public information and education.

The first result of ASAP's systems approach were published in a 1974 report (U.S. Department of Transportation 1974). The data were taken from eight projects that had collected three years of "baseline" data and two years of "operational" data. In addition there were three years of baseline and one year of operational data from twenty-one sites initiated a year later than the first eight sites.

Large increases in activity were noted in the report. For example, arrests rose more than 100% overall and 60% of those arrested were processed by the courts. The increases in activity were not, however, reflected in proportionate decreases in night fatal crashes (a surrogate measure for alcohol-related fatalities), the measure of effectiveness used by NHTSA. On the average, night fatal crashes per licensed driver decreased from 12.9 to 12.5, or only about 3%. No correlation was found between ASAP activity and highway safety impact. Nevertheless, NHTSA reported that the ASAP resulted in from 65 to 174 fewer fatalities over a period of 2 years in the 8 initial sites. The averted fatalities represent a dollar savings to society of \$13 to \$35 million, compared to an outlay of approximately \$14 million over 3 years.

NHTSA's findings on ASAP impact have been disputed by many analysts. For example, a more rigorous analysis by Zador (1976) compared the ASAP crash figures with those in comparison cities with similar highway safety and other attributes.

Zador found decreases in the proportion of night fatal crashes to day fatal crashes in the ASAP areas, but concluded that the ASAP countermeasures could not have been responsible for the observed reductions in the ratio of night fatal crashes to day fatal crashes and that "ASAP's large scale social programs have been ineffective" (Zador 1976, p. 48).

A second NHTSA evaluation report (U.S. Department of Transportation 1975a) used additional data to analyze the impact of the twenty-one later ASAPs after two years of operation. This report found some evidence of a reduction in alcohol-related fatal crashes that could be attributed to ASAP and questioned Zador's analysis claiming that his control groups were actually comparison groups that did not adequately match the ASAP groups. In a later article Zador (1977) repudiated NHTSA's criticisms and held to his original conclusions about ASAPs ineffectiveness as large-scale social programs.

The latest ASAP evaluation report (U.S. Department of Transportation 1979) departed from the approach of the previous two evaluations and evaluated each ASAP site separately rather than evaluating the ASAP program across all sites. The evaluators found that twelve of the thirty-five ASAP sites showed significant reductions in nighttime fatal crashes. This evaluation also used comparison sites selected on the basis of the following attributes: percentage urban, fuel expenditures per capita, dollars spent in eating and drinking establishments, drinking age, and population change for one year. The site-matching procedure resulted in some interesting site pairs, such as Washtenaw County, Michigan, and San Diego, California; Birmingham, Alabama, and Delaware; and Lincoln, Nebraska, and Pittsburgh, Pennsylvania.

The actual effectiveness of the ASAP program is unknown and may never be known. NHTSA has never published all the original data and reports from the individual sites. This has occurred even though federal law, U.S. Department of Transportation regulations, and NHTSA's own regulations require the prompt release of such data and reports. Instead, NHTSA has chosen to publish its own "evaluations" of the ASAP program. Needless to say, the NHTSA publications are generally positive about the "results" of the ASAP effort.

In 1979 and 1980 NHTSA placed copies of

many of the ASAP reports in the NHTSA Technical Library. While this action greatly increased the availability of the reports, it did not make them accessible to many likely users. The delay in making the reports available also reduced their utility for

Perhaps, the most important lesson to learn from the ASAP experience is how complex a problem traffic crashes really are and that simplistic, single-focus solutions are not likely to produce results.

policy formulation and the likelihood of independent review.

Practitioners should read the NHTSA evaluations with a critical perspective. Acceptance of all claims of success is not warranted. Some general points are reasonable; for example, the general deterrence concept that uses the legal approach coupled with public information and education seems the most reasonable approach available today.

Perhaps, the most important lesson to learn from the ASAP experience is how complex a problem traffic crashes really are and that simplistic, single-focus solutions are not likely to produce results. It is also important to recognize that knowledge must exist before demonstration can occur. The ASAPs were intended as "demonstration projects" to show how "known

Practitioners planning local programs should recognize that alcohol is a long-term public health problem. Alcohol use and misuse existed long before the automobile.

methods" could deal with the drinking driver. What the ASAPs did show was that the knowledge did not exist in sufficient detail to warrant demonstration in the first place. Discovery had not been completed before the demonstration began.

The ASAPs are a complex chapter in the history of highway safety. They represent the expenditure of huge sums of money and honest effort by many people with, at best, limited success. There are, of

course, many reasons for the limited success. Two premises that influenced the design and initial planning of the program contributed significantly to the lack of success and should be avoided in the future.

First, the ASAPs were conceived as a federal demonstration program that would show local jurisdictions how to deal with a local problem. The belief that the federal government had a better understanding of how to deal with local problems than local people was widely held in federal agencies in the sixties and seventies. ASAP was only one of a number of federal demonstration programs that failed to achieve success.

Second, the initial focus of ASAP on the problem drinker (an imprecise term) as the primary target was too simplistic. The initial goal was to reduce alcohol-impaired driving through special deterrence. Treatment, in many cases, was substituted for traditional legal sanctions. When it became apparent that the program had not had a significant effect on deterring the problem drinker (Nichols et al. 1978), the objectives of the program were simply redefined to that of a general deterrence program (U.S. Department of Transportation 1979) and evaluations conducted in the new context. Thus, the final evaluations of the program do not measure the success in terms of the initial objectives.

Practitioners planning local programs should recognize that alcohol is a long-term public health problem. Alcohol use and misuse existed long before the automobile. Alcohol-impaired driving creates traffic crash risk and requires a highway safety risk management response. The response, however, must be based upon an adequate understanding of the risk; the limitations of current knowledge; and the realization that a long-term continuing program will be required.

Summary

The alcohol-crash problem is one of the most researched areas in the field of highway safety. Large sums of money have been spent on efforts to reduce its magnitude. Despite this activity, the alcohol-crash risk remains at about the same level as it was twenty or more years ago. We predict no significant changes in the short term in the conditions that create this risk.

The alcohol-crash problem first identified in 1904 is still with us today, but on a much larger

scale. Epidemiologic research indicates that some one-half of all fatally injured drivers were legally too intoxicated to drive (that, is had a BAC of .10% w/v or more). An estimated 5% to 13% of drivers in less serious crashes also had these high BACs. We do not know how many of these crashes were actually caused by alcohol, but research shows

For the immediate future, our methods of dealing with this problem must continue to rely mostly on traditional approaches because there are no greatly improved new approaches nearing readiness for use.

that the risk of a serious crash increases greatly as the driver's BAC approaches .10% w/v. The fact that many basic skills related to driving are impaired in most individuals at BACs of .10% w/v or more provides further evidence that alcohol is a causal factor in a great many crashes that involve drivers with these BACs. Research also indicates that alcohol is a factor in more than one-third of all adult pedestrian fatalities.

Responses to the alcohol-crash problem have relied mostly on traditional societal systems for controlling dysfunctional behavior. Of these, the legal system with its formal lawmaking, enforcing, adjudicating, and sanctioning elements have been

The present state of knowledge suggests that punitive sanctions, especially license revocation and suspension, have the greatest effect on reducing future drunk driving violations among drivers who have been caught and punished for drunk driving.

the primary mechanism. Its strategy has been based largely on the concept of deterrence. It operates on the premise that a driver contemplating driving after drinking will be deterred if he or she believes the punishments that would result would outweigh the benefits.

In recent years, this legal approach has been combined with a health approach that envisions drunk driving as an illness and a public health

problem that can and should be treated rather than punished. Both of these approaches have been supported by a public information and education (PI&E) approach and by modern technology. Comprehensive systems approaches employing elements of all these approaches have been tried in some jurisdictions.

Sadly, none of these approaches has yet had much of an effect on the problem. Only the British Road Safety Act of 1967, a legal approach with a heavy PI&E component, has shown unequivocal results; however, its effects did not last. This unfortunate state of affairs is compounded by the fact that we still do not know why the various approaches did or did not work.

For the immediate future, our methods of dealing with this problem must continue to rely mostly on traditional approaches because there are no greatly improved new approaches nearing readiness for use. The legal system will remain the main control mechanism, identifying drunk drivers through enforcement action and punishing or treating those found to have violated drinking driving laws.

At present, it appears that the legal approach operates best in a **general deterrence** mode in which combined legal-PI&E actions are aimed at broad target groups of drinking drivers. Local jurisdictions should "beef up" their current legal system efforts to ensure that they present a credible threat to drivers in terms of probability of their apprehension and receiving a suitably unpleasant punishment. Locally oriented PI&E programs should be used to convey information about that threat as well as the related threat to safety posed by drunk driving.

In focusing on general deterrence, the **special deterrence** mode should not be abandoned. The present state of knowledge suggests that punitive sanctions, especially license revocation and suspension, have the greatest effect on reducing future drunk driving violations among drivers who have been caught and punished for drunk driving. However, such sanctions alone seem more appropriate for drivers who have not yet developed a serious drinking problem. Problem drinkers appear to require treatment as well as punishment. Although the highway safety value of a treatment-oriented approach has not yet been established, it is sound from a conceptual and humane point of view and should continue to be practiced.

Recommendations for Action

The previous sections have provided an overview of the alcohol-crash risk and management actions undertaken in the past to deal with the risk. While no single approach has achieved dramatic success in reducing alcohol-impaired driving, current knowledge suggests that local programs to deal with impaired driving are needed and should contain the following elements.

Identify The Alcohol Crash Risk

The nature and magnitude of the risk created by alcohol-impaired drivers should be established to form the basis for countermeasure programs. The size of the problem will have to be established to persuade the public and public officials to take and support action to reduce the risk. Calculation of alcohol-related crash losses in terms of deaths, injuries, and costs is necessary. Comparisons can then be made with other risks that the community accepts as important to manage (such as fire, crime, disease, and pollution).

Precisely establishing the risk is also necessary for the evaluation of programs designed to reduce it. Obviously, if the magnitude of the risk is unknown prior to the start of a countermeasure program, it will be impossible to determine whether the program has any effect.

Select Risk Management Strategies and Tactics and Allocate Resources

Understanding the nature of the alcohol-crash risk in a jurisdiction provides a framework for selection of strategies and tactics. Specific targets for action are also likely to be suggested by the experience of past crashes. These may include, for example, specific locations or times of the day where enforcement resources should be concentrated.

Current knowledge suggests that the best general strategy is the legal approach accompanied by public information and education programs. Referral of individuals with drinking problems to health care facilities is probably warranted but may not have significant highway safety benefits.

A more detailed description of strategies and tactics is provided in the literature contained in the Bibliography.

Implement Risk Management Actions

Implementation of the selected strategies and tactics should be accomplished from a risk management perspective. All involved should keep the ultimate objectives in mind, and avoid mere activity.

Likely specific actions will include:

- Enactment of an adequate legal base.
- Rigorous enforcement.
- Adjudication and sanctioning from a highway safety perspective. License suspension or revocation should be

considered for repeat offenders and, when warranted, for first offenders.

- Public information and education programs to create an understanding of the alcohol risk and the actions that are being undertaken to manage it. The objective should be to create a climate of public opinion that makes alcohol-impaired driving socially unacceptable. Individuals should also be made aware what will happen to them if they are caught driving while impaired. Establishing the climate of societal opinion and the perception of what will happen to alcohol-impaired drivers who are caught are important elements of a general deterrence approach.
- Referral of individuals with a drinking problem to treatment facilities. Care should be taken to ensure that highway safety objectives are met. Treatment alone may not deter individuals from continuing to drink and drive.

The literature identified in the Bibliography provides more detail on the implementation of risk management actions.

Evaluate Outcomes in Terms of Risk Reduction

Evaluation of the risk management program is an essential part of its structure. Absent an evaluation component, there is no objective measure of success. It would be like trying to run a for-profit enterprise without ever creating a balance sheet.

Evaluation will not be easy. Not every program can afford nor will warrant a full-scale scientific evaluation. Still, every program must develop some measures of performance. Perhaps the most important thing to remember when creating the evaluation component is the objective of the program—the reduction of the traffic crash risk caused by alcohol-impaired drivers. Evaluation should measure risk reduction, not activity. While it is important to know how many people are arrested, charged, found guilty, sentenced, referred to treatment, and so forth, this information by itself is a mere description of activity. Measures that relate more directly to the risk should be sought.

Accidents, however, are a relatively infrequent event, and subject to many intervening variables; thus they may not be a useful measure. Measurement of the frequency of drinking driving, social attitudes about drinking and driving, and similar measures that relate to the problem should be considered.

Evaluation has been one of the areas most overlooked in the past so that ample room exists for innovation. A word of caution is necessary—the literature on alcohol and highway safety is replete with claims of success that are based on poor data and poor analysis. In some cases, evaluators have fooled some people. In other cases, they appear to have fooled themselves. Alcohol and highway safety is a complex problem; it is easier to be fooled by it than to really address it. Efforts to solve the problem, therefore, should be evaluated with care.

The approaches discussed above are oriented toward the present and the near-term future. Based on past history, their effect in reducing overall alcohol-crash risk in most jurisdictions will likely be small, although large improvements in efficiency may be realized. We believe that a broad-based, continuing program of research is needed to develop substantial reductions in alcohol-crash risk.

In the area of risk identification, epidemiologic studies are needed to determine the risk faced by various population groups at various BACs, and to describe the circumstances surrounding alcohol-related crashes, as well as the interactions of alcohol with other factors that cause crashes. More experimental research is also needed to better define the effects of alcohol on driving tasks as performed by groups indicated by past research to have either a high alcohol-crash risk or a high alcohol-crash involvement. Critical research needs in the area of risk management strategy and tactics include a comprehensive analysis of targets of possible alcohol-safety programs, studies to identify both deterrent threats and treatments most appropriate to drinking drivers, studies to determine specifically how public information and education programs can be used in drinking driver control efforts, and programs to develop and apply new technology to existing and new alcohol-safety approaches.

Local jurisdictions can play an important role in this research. They provide a "living laboratory" for testing and evaluating these new ideas. They should participate in the research and planning process by identifying information needs to be addressed by future projects. Thus, the participation of operational agencies in research is as important to the success of long-range alcohol-safety programs as their involvement in current traditional approaches is to the success of short-range programs.

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Acknowledgement

Development of this independent paper was supported by an unrestricted grant by the Motor Vehicle Manufacturers Association. The assistance and advice of our colleagues are gratefully acknowledged.

