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**Countermeasures to
Address Impaired
Driving Offenders**
Toward an Integrated Model

A Symposium
August 15–16, 2011
Beckman Conference Center
Irvine, California

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Alcohol, Other Drugs, and Transportation Committee
Transportation Research Board

August 2013

Transportation Research Board
500 Fifth Street, NW
Washington, D.C.
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Many members of the committee worked to make this event possible. Special thanks are extended to Susan A. Ferguson, Kathryn Stewart, and Doug Beirness for the organization and planning of the workshop. Additional thanks are extended to Susan A. Ferguson for compiling this circular.

Foreword

A number of strategies have been used to reduce reoffenses among impaired drivers. These include sanctions intended to separate drinking from driving, sanctions that incapacitate offenders so that they cannot drive or cannot drink or cannot combine the two, and education and rehabilitation to reduce drinking problems and impaired driving.

The Alcohol, Other Drugs, and Transportation Committee of the Transportation Research Board (TRB) convened a workshop to review and integrate the current state of knowledge about how best to deal with impaired driving offenders and to work towards an integrated model that can have the maximum effect on safety. Presentations were invited from committee members and others with specialized expertise.

During the workshop, extensive discussion ensued after each presentation. The presenters then submitted the background papers contained in this e-circular. A draft of this e-circular was distributed to the committee for review and comment. The workshop was held August 15–16, 2011, at the National Academies' Beckman Conference Center in Irvine, California. This report provides an overview of the information presented and the discussions among the participants. Also included are the background papers and presentations.

Overview and Summary

SUSAN A. FERGUSON

Ferguson International, LLC

A number of strategies have been used to prevent or reduce reoffenses among impaired drivers. These include sanctions intended to separate drinking from driving, sanctions that restrict offenders so that they cannot drive, cannot drink, or cannot combine the two, and education and rehabilitation to reduce drinking problems and impaired driving. Although all of these strategies have shown some level of success, they are often applied unevenly and enforced poorly. In addition, little is known about how these various approaches can be combined for maximum efficiency and effectiveness. This workshop was designed to bring together researchers and policy makers to discuss the current state of our knowledge about how best to deal with impaired driving offenders and to work towards an integrated model that can have the maximum effect on safety.

BACKGROUND AND STRUCTURE OF THE WORKSHOP

There are many approaches that attempt to deter those who have been arrested for alcohol-impaired driving from reoffending. Deterrence is just one goal of criminal law (Ross, 1984). Other goals are retribution, incapacitation, and rehabilitation. Retribution recognizes that an individual has engaged in a prohibited behavior, and the goal is to punish the individual in some way that may or may not affect the desire to offend again. Incapacitation seeks to restrict the offender from committing additional violations on the assumption that there is no internal motivation to prevent the individual from reoffending. There are many ways to achieve this goal ranging from incarceration, which could be considered the most restrictive, to restricted driver licenses. Rehabilitation is considered a nonpunitive approach where the offender receives education and treatment with the goal of changing the underlying drinking problem and impaired driving so that the offender will choose not to reoffend. The various countermeasures employed may vary in terms of their reliance on these goals, and in some cases may encompass more than one aspect. The workshop addressed countermeasures to address driving-while-intoxicated (DWI) offenders, thus, the discussion of these approaches focuses primarily on the specific deterrent effects on the offenders themselves. However, speakers also were asked to identify where evidence exists for general deterrent effects.

The workshop discussions began with the presentation of a framework for an integrated approach for management of DWI offenders. Discussions of the individual countermeasure approaches that followed were categorized as to whether they were driver based or vehicle based. Vehicle-based discussions included an overview of the effectiveness of alcohol-ignition interlocks, followed by a discussion of plate- and vehicle-impoundment sanctions. Driver-based sanctions included incarceration and license suspension actions, as well as ways to improve offender monitoring to ensure offenders comply with sanctions. Next, speakers addressed behavior change and rehabilitation. Discussions began with a framework for how to promote sustained change, and were followed by discussions of one model that attempts to address the underlying causes of impaired driving and protect public safety by holding offenders

accountable, that is, driving under the influence (DUI) courts. At the conclusion of these presentations, experts were asked to provide comments on the integrated framework and indicate how the various pieces might fit together. The first speaker provided comments on the usefulness of various approaches to provide incapacitation monitoring, feedback to treatment providers, and the use of data to craft interventions. Other speakers provided research practitioner and judicial perspectives. A final speaker was asked to draw conclusions from the available research and discuss research needs.

OVERVIEW OF DISCUSSIONS

National Integrated Model for Management of DUI Offenders

DUI management programs vary widely among the states. They operate under two authorities: the local criminal courts and the states' departments of motor vehicles, whose authority over drivers' licenses provides them with the power to establish DUI education or treatment requirements and to require interlocks as a provision for relicensing suspended drivers. With the exception of drug and alcohol courts, treatment is not well integrated with the sanctions supervised by the probation department. Offenders frequently avoid mandated treatment requirements until they apply for license reinstatement. Most treatment providers do not receive client information from the court and treatment providers generally provide only attendance information to the court. Information on the effectiveness of the overall offender management program or its elements is generally lacking.

The cost and overcrowding of jails stimulated the development of drug and DUI courts that, though less expensive than jail, still involve a considerable investment of court personnel time. This, in turn, has led to the development of reduced versions of the drug court system that principally rely on monitoring, reinforced by brief jail periods for offenders who fail to comply with requirements. This movement to reduce jail costs by using community correction programs involving close monitoring of offender behavior has been assisted by the technological advances in monitoring systems such as vehicle interlocks and transdermal and photo-breath-test monitoring systems that are relatively low cost and are paid by the offender. Also stimulating this movement is the general recognition that license suspension is only partially effective because up to 75% of suspended offenders drive illicitly. Finally, states have begun to pass laws providing for increased penalties for first DUI offenders with high blood alcohol contents (BACs) and encouraging courts to apply technological monitoring systems such as vehicle interlocks and electronic monitoring of alcohol consumption to first offenders.

This movement away from reliance on jail and license suspension as the principal control method for DUI offenders opens an opportunity to consider more integrated and flexible options for managing DUI offenders. It also offers the opportunity to develop a broader national model for states to consider. The development and implementation of such a model, aside from stimulating uniformity across states, should encourage the evaluation of current programs, the development of new programs, and the stimulation of technological developments. This paper outlines such a plan; see the section titled "Is a National Integrated Model for Management of DUI Offenders Possible?" (p. 8).

Vehicle-Based Sanctions

Breath–Alcohol Ignition Interlocks

Breath–alcohol ignition interlocks are aftermarket breath-testing devices that can be installed in vehicles and measure drivers' BACs. These devices require drivers to provide breath samples before starting their vehicles. If a positive breath alcohol concentration is registered, the vehicle will not start. The devices record breath test data from all attempted starts. These data are provided to probation officers to monitor the drinking and driving behavior of offenders.

The primary purpose of breath–alcohol ignition interlocks is to prevent DWI offenders from reoffending and there is good evidence that they are effective for this purpose. There have been numerous studies that have examined the efficacy of breath–alcohol ignition interlocks in reducing DWI re-arrest rates. The available scientific evidence clearly indicates that offenders with ignition interlocks on their vehicles are at a substantially lower risk of reoffending compared with offenders who have had their licenses suspended. Pooling the data from many of the studies, Elder estimated the median effect as a reduction of 67% (range –85% to –50%) in recidivism. Effect sizes were similar for first time and repeat offenders.

The effects on rehabilitation are not as positive. Once interlocks are removed from offenders' vehicles, re-arrest rates typically go back up, with recidivism rates that are similar to those of the comparison group. This suggests that there is little specific deterrent effect of ignition interlock programs. Moreover, no evidence currently is available for a general deterrent effect of ignition interlocks; see the section titled “Overview of Effectiveness of Ignition Interlocks: Reflections from the Perspective of Theories of Punishment” (p. 32).

Impoundment, Forfeiture, and License Plate Sanctions

The goal of vehicle-based sanctions is to make it more difficult, if not impossible, for DWI offenders to drive their vehicles while impaired by alcohol. DeYoung described three major categories. Sanctions that (a) increase the conspicuity of the vehicle by marking or confiscating the license plate or registration tags; (b) physically remove offenders' access to their vehicles by immobilizing, impounding, or forfeiting them; (c) allow access to the vehicle but prevent it from being driven after drinking by installing a breath–alcohol ignition interlock on the vehicle.

A major impediment to enforcing license suspensions is that there is no way to identify that a driver has a suspended license without stopping the vehicle. The intention of license plate actions, while not physically preventing anyone from accessing their vehicle, is to deter suspended drivers from driving by making their vehicle more noticeable to law enforcement if they do. More intrusive methods include vehicle immobilization, impoundment, and forfeiture. All sanctions have some evidence of effectiveness but not much is known about how long they should remain in effect. DeYoung suggests that a longer term may not always be better but that the certainty and swiftness of action may be more important. He further suggests that immobilization may be preferable to forfeiture because forfeiture is administratively more cumbersome, no more effective, and may be less acceptable to the general public; see the section titled “Controlling the Risk of Impaired Drivers Through Use of Vehicle-Based Sanctions: Impoundment, Forfeiture, and License Plate Sanctions” (p. 20).

Driver-Based Sanctions

Incarceration, License Suspension, and Revocation

The traditional approach in dealing with DWI offenders is to require a brief incarceration, followed by a longer license suspension or revocation, coupled with alcohol and drug education and treatment. The goals are to prevent offenders from repeat alcohol-impaired driving and at the same time break their dependence on alcohol so that they will not reoffend in the future once sanctions have been lifted; that is, to control the risks that such individuals present to public safety.

All states allow DWI offenders to be sentenced to jail. Although there may be compelling reasons to require a jail term for DWI offenders, the evidence for its effectiveness is less than compelling. There is little evidence that incarceration, or its threat, is an effective countermeasure in deterring alcohol-impaired driving.

License suspension or revocation is one of the most widely used and extensively studied sanctions for the control of alcohol-impaired driving. There is the potential for license suspension to have both specific and general deterrent effects, because drivers who have had their license suspended or revoked should be less likely to drive, including while impaired by alcohol. The general public may be deterred from driving impaired for fear of losing their license. Licenses are taken away by the courts after conviction. Thus, one of the drawbacks of court-imposed license sanctions is that there is often a significant time lapse between the date of the arrest and the conviction and imposition of the license suspension. This lack of certainty and swiftness in the system means that individual offenders escape punishment for some time. But perhaps more importantly, because the suspension is delayed, they could continue to drive while impaired. Administrative License Suspension (ALS) or Administrative License Revocation (ALR) laws were enacted to bridge this gap. Under ALS-ALR laws, police officers are authorized to confiscate driver licenses at the time of the arrest for drivers who either fail or refuse to take a chemical test for alcohol. There is very little evidence that post-conviction license suspension can result in a general deterrent effect, however, ALS-ALR has been shown to have a modest general deterrent effect.

In terms of specific deterrence, both pre- and post-conviction license suspensions are effective countermeasures for DWI offenders, resulting in lower recidivism and alcohol-related crash rates. This is in spite of the fact that suspended drivers may continue to drive, although less often and more carefully. Post-conviction license suspension is especially effective when combined with an alcohol treatment program; see the section titled “Traffic Safety Impact of Judicial and Administrative Driver’s License Suspension” (p. 41).

Monitoring

Closely monitoring offenders can improve the likelihood that they will not reoffend. There are a number of innovative ways to improve overall adherence to suspension or revocation, some of which are vehicle based, some of which are based on monitoring the individual, and some of which require offenders to travel to a specified facility for alcohol testing.

This paper discusses a variety of monitoring devices. Breath–alcohol ignition interlocks, in addition to preventing vehicles being driven after drinking, can also be used to monitor whether drivers have been drinking prior to starting their vehicles. They have the added benefit

that test data can be used to predict whether people will reoffend. Interlocks are often underutilized because DWI offenders' licenses are suspended or they claim to not own a vehicle. A recent, lower-cost alternative to monitor alcohol use is a portable BAC test device that can be installed in the home. Remote transdermal devices that measure alcohol eliminated from the body through sweat are designed for daily monitoring of alcohol consumption and are suitable for offenders who are court ordered to abstain from alcohol. These data are gathered through the use of electrochemical technologies and can be remotely transmitted for review by criminal justice professionals. Alcohol biomarkers can be measured in several different body matrices (e.g., blood, hair, urine), extending the surveillance window and allowing for more evidence-based judgments about the extent to which a driver has gained control of his or her alcohol use. Other monitoring methods were also discussed that do not measure alcohol per se, but include electronic monitoring of home arrest, and devices that monitor whether a suspended driver is driving by using an ankle-mounted motion detector that senses movements typical of driving; see the section titled "Technologies to Monitor the Behavior of Alcohol-Involved Drivers (p. 54).

REHABILITATION

Reducing Recidivism and Promoting Sustained Change

Monitoring a DWI offender after conviction, whether that includes monitoring drinking or drinking and driving, has the potential to hinder or even prevent individuals from engaging in these behaviors. The challenge is how to maintain these gains once the sanctions are lifted because evidence suggests that behavior may return to former patterns. A DWI arrest provides an opportunity to identify problem drinkers and refer them to treatment, what DiClemente calls a "teachable moment." He points out that there is a difference between stopping a behavior and changing a behavior. This point hinges on the distinction between imposed change and chosen change; sanctions can be considered a form of imposed change. The process of change is complex and involves many stages. It is not always a linear process, as individuals often undergo relapses when stages are not completed successfully. The question is, how can sanctions be integrated into the known processes of change to sustain behavioral change over the long term?

This paper discusses the process of change, highlighting the difference between chosen (intentional) change and implemented change, and outlines the interaction of this process with the stages of change. It also highlights ways to foster integration of the intentional change process into the use of sanctions or punishments and some barriers to accomplishing this goal; see the section titled "Reducing Recidivism and Promoting Sustained Change: A Process of Change Perspective" (p. 80).

Sanctions and Rewards in DUI–DWI Court Settings

DUI–DWI courts are patterned after specialized courts for drug offenders, and offer extensive monitoring of DWI offenders' driving behavior and alcohol use. They provide a systematic and integrated approach to prosecuting, sentencing, treatment, and monitoring of DWI offenders with the goal of protecting public safety while addressing root causes of impaired driving. A team of criminal justice professionals and treatment professionals meet regularly to monitor progress and

change sanctions or treatment as necessary, thus holding offenders accountable. There are currently more than 500 DWI courts nationally, compared with more than 2,000 drug courts.

Because DUI–DWI courts are a somewhat recent innovation, research on their effectiveness is limited. This paper presents what is known about the use of sanctions and rewards in the DUI–DWI court process, as one strategy to address impaired driving. The existing research on DUI–DWI courts is presented, followed by a brief description of how DUI–DWI courts overlap with alcohol abstinence research findings. The paper also discusses research on the use of sanctions and rewards in DUI–DWI courts, followed by factors to consider in sanctions and rewards, and how to capture the sanctions and rewards process in evaluation research; see the section titled “Sanctions and Rewards in DWI–DUI Court Settings” (p. 87).

REVISITING THE FRAMEWORK FOR AN INTEGRATED MODEL

At the conclusion of the presentations, several speakers were asked to provide comments on the integrated model and guidance on how these pieces might fit together. One speaker provided comments on how technological components and the ability to provide monitoring and feedback to treatment providers would fit in with the model. Another speaker provided the perspective of a research practitioner, and a judge with the Superior Court of California was asked to provide the judicial perspective. A final speaker provided a wrap-up of the workshop discussions. Summaries of these remarks can be found after the presented papers; see the section titled “Revisiting the Framework for an Integrated Model” (p. 104).

REFERENCE

Ross, H. L. *Deterring the Drinking Driver*. DC Heath and Company, Lexington, Mass., 1984.

Is a National Integrated Model for Management of DUI Offenders Possible?

ROBERT B. VOAS

Impaired Driving Center

This paper covers emerging policies for managing drivers who have been convicted of a driving-under-the-influence (DUI) offense. Sanctions for driving-while-intoxicated (DWI) offenders are designed based on two broad objectives: (a) to promote the general deterrence of all drivers from impaired driving and (b) to promote the specific deterrence of the drivers convicted of DUI from repeating the offense. Specific deterrence involves two key functions: to rehabilitate offenders to reduce the risk they present to other road users to that of an average driver and to supervise their driving or their drinking while they are undergoing behavioral change to ensure that they do not injure other road users.

Although recognizing the significance of general deterrence, this paper addresses only specific deterrence of DUI offenders who are 4.1 times more likely to become an intoxicated driver in a fatal alcohol-related crash (Fell, 1992). Fatal crashes involving drivers with a DUI conviction in the last 3 years account for 1,000 fatalities a year (NCSA, 2006). The high cost (jail) and reduced effectiveness (license suspension) of traditional offender control mechanisms is leading to low-cost supervisory techniques based on evolving technologies for monitoring drinking and driving and alcohol and drug consumption. This is opening an opportunity for the development of a national model for the management of DUI offenders. This paper examines that opportunity and the research issues it raises.

BRIEF HISTORY

For the first half of the 20th century, the principal tools available to courts for managing DUI offenders were fines, license suspension, and jail. The latter was primarily applied to multiple offenders and drinking drivers responsible for the injury or death of innocent road users. Although license suspension was the primary evidence-based sanction for DUI (Peck, 1991), over time concern for the impact on the employment status of the offender and a growth in the effectiveness of defense attorneys eroded the use of suspension as more emphasis was placed on fines and more offenders' avoided of suspension.

1970s

A new phase in the management of DUI offenders was born with the founding of the U. S. Department of Transportation (DOT) in 1966. The first publication issued by what was to become the National Highway Traffic Safety Administration (NHTSA) was on Alcohol and Highway Safety (U.S. DOT, 1968) and focused on the problem drinker as the principal factor in alcohol-related crashes. In response to that document, the U.S. Congress authorized NHTSA to conduct a national community demonstration program involving 35 Alcohol Safety Action Projects (ASAPs) that mandated treatment programs for DUI offenders (Levy et al., 1977; Voas, 1981).

A key feature of this program was the identification of two levels of offenders: social drinkers (generally first-time offenders) and problem drinkers [multiple offenders or first offenders with high blood alcohol concentrations (BACs) or prior treatment for alcohol problems]. The ASAP intervention model was based on the concept that the offenses of social drinkers primarily resulted from a lack of knowledge and that the appropriate response was to provide a 10- to 12-h education program. Problem drinkers were assumed to have an alcohol use disorder (AUD) that required longer-term therapy (Nichols et al., 1978).

The ASAP program conducted a number of evaluations to assess the effectiveness of these intervention efforts with limited success (Voas, 1972). Education programs for social drinkers were found to reduce recidivism by 10% (Nichols, Weinstein, et al., 1978; Nichols, Ellingstad, and Struckman-Johnson, 1978), but none of the evaluations of treatment programs for problem drinkers have provided evidence for their effectiveness (Stewart and Ellingstad, 1989). Despite these discouraging results, the ASAP program stimulated the nationwide adoption of treatment as a component of the DUI sanctioning system. This extensive use of education or treatment interventions was facilitated by their low cost to the government because the offender paid for them (Voas, 1981).

1980s

A decade later, the emergence of the citizens activist movement, led by Mothers Against Drunk Driving (MADD) (Voas, 1972), hardened public attitudes regarding impaired driving and changed the criminal justice environment in two significant ways. First, there was strong opposition to letting DUI offenders off with a fine and pressure mounted for longer and more certain license suspension penalties. Public attitudes and research emanating from the ASAP programs—which indicated that motivating offenders to attend treatment by allowing them to keep their licenses was counterproductive because the increased exposure to crash involvement overwhelmed the benefit of the treatment (Peck, Sadler, and Perrine, 1985; Perrine and Sadler, 1987)—resulted in the general abandonment of that practice in favor of requiring treatment as a condition of probation. There is evidence for the effectiveness of treatment when exposure is not increased (DeYoung, 1997).

A second change in the handling of DUI offenders resulting from the change in the criminal justice environment was an emphasis on incarceration of both first and multiple DUI offenders. Although several states passed legislation providing minimum (generally 48 h to a week) jail terms for first offenders, that effort was aborted by the lack of jail facilities (Voas, 1985). Most state detention facilities were overcrowded and many facilities were under court orders to reduce their population. Consequently, most of the DUI offenders sentenced to jail were diverted into highway work details and other community service programs (Voas, 1985). Further, research indicated that jail as an effective countermeasure beyond the time of incarceration lacked evidential support. (Voas, 1986; Wagenaar et al., 2007).

1990s

New technologies that monitor offender's drinking, driving, and movements in the community, thereby reducing the need for jail facilities, were developed and generally began to be used in the criminal justice system in the 1990s. Notable among these was electronically monitored home confinement, some of which offered remote (over the telephone) monitoring of the offender's BAC (Jones et al., 1988). Portable Global Positioning Systems were developed to monitor and

limit the geographical position of criminal offenders, and, most relevant to current DUI control systems, the vehicle alcohol ignition interlock began to be widely applied to multiple offenders (Marques et al., 1999; Voas and Marques, 1992). Extensive evidence for the interlock's effectiveness in reducing recidivism led to a MADD campaign in the following decade to extend its use to first offenders.

2000s

The last decade has seen the implementation of new technological methods for monitoring the drinking of DUI offenders. Notable among these was the development and implementation of transdermal alcohol monitoring systems, such as the Secure Continuous Remote Alcohol Monitoring system, which is a bracelet worn around the ankle that senses BAC (Marques and McKnight, 2009). Advances in toxicology have also provided a method for monitoring alcohol consumption through blood markers that can be detected in urine, oral fluid, and hair, as well as in blood (Marques et al., 2010). Finally, new photographic techniques that can identify the individual providing a breath sample have established a basis for the development of portable alcohol test equipment that can be used to monitor DUI offender drinking by requiring multiple tests during the day (Voas, 2011).

Also coming into wide use during this period were DUI courts (an offshoot of drug courts) for multiple offenders subject to substantial jail terms. Rather than serving their sentences, offenders were offered an opportunity to participate in a supervised intervention program for year or longer. The adjudication model features an extension of the intensive probation supervision concept to include regular monthly or bimonthly court appearances of the offender before the judge, along with both the probation officer and the treatment provider who review the reports and assess the progress in the offender's recovery program (Rempel et al., 2003). Based on those reports, the judge can reduce the jail time for compliant offenders. Initial evaluations suggest that DUI courts can be effective (Fell, Tippetts, and Ciccel, 2011; Marlowe et al., 2009).

CURRENT STATUS OF PROGRAMS TO MANAGE DUIs

Currently, DUI management programs vary widely among the states. They operate under two authorities: the local criminal courts and the states' departments of motor vehicles, whose authority over driver's licenses provides them with the power to establish DUI education or treatment requirements and to require interlocks as a provision for relicensing suspended drivers. Outside the drug and alcohol courts, treatment is not well integrated with the sanctions supervised by the probation department (Voas and Fisher, 2001). Offenders frequently avoid mandated treatment requirements until they apply for reinstatement (Voas, Tippetts, and McKnight, 2010). Most treatment providers do not receive any information on their clients from the court and treatment providers generally provide only attendance information to the court. Information on the effectiveness of the overall offender management program or its elements is generally lacking. Although Wagenaar and his coworkers have conducted three recent studies of state sanctions for DUI offenders (Wagenaar et al., 2007; Wagenaar and Maldonado-Molina, 2007; Wagenaar et al., 2007), there have been no comprehensive reports on court treatment programs for DUI offenders. The last comprehensive meta-analysis of DUI treatment programs was conducted by Wells-Parker et al. (1995).

OPPORTUNITY FOR COMPREHENSIVE APPROACH

Jail costs have become a major problem for the 50 states. In the United States, more offenders are incarcerated than in any other country in the world, and much of the jail space is occupied by nonviolent alcohol and drug abusers. The problem is exacerbated by the current economic downturn that has forced some states to implement early release programs for a large number of offenders (Long, 2009; Voas et al., 2011). The cost and overcrowding of jails stimulated the development of drug and DUI courts that, though less expensive than jail, still involve a considerable investment of court personnel time. This, in turn, has led to the development of reduced versions of the drug court system that principally rely on monitoring, reinforced by brief jail periods for offenders who fail to comply with abstinence requirements. The best known examples of such a system is the South Dakota 24/7 Sobriety Project (Bachand, 2008; Long, 2009) that requires offenders to visit a police station to be tested for alcohol twice a day at 7 a.m. and 7 p.m. Failures to appear or positive tests are met with immediate short-term periods in jail. Treatment is not a formal part of the 24/7 program, although it is available at the offender's expense as one element of the overall sanctions program.

This movement to reduce jail costs by using community corrections programs involving close monitoring of offender behavior has been assisted by the technological advances in monitoring systems such as vehicle interlocks and transdermal and photo-breath-test monitoring systems that are relatively low cost and are paid for by the offender. Also stimulating this movement, is the general recognition that license suspension is only partially effective because up to 75% of suspended offenders drive illicitly (Ross and Gonzales, 1988). Finally, states have begun to pass laws providing for increased penalties for first-time DUI offenders with high BACs (McCartt, Geary, and Nissen, 2002.) and encouraging courts to apply technological monitoring systems such as vehicle interlocks and electronic monitoring of alcohol consumption to first offenders.

This movement away from reliance on jail and license suspension as the principal control method for DUI offenders opens an opportunity to consider more integrated and flexible options for managing DUI offenders. It also offers the opportunity to develop a broader national model for states to consider. The development and implementation of such a model, aside from stimulating uniformity across states, should encourage the evaluation of current programs, the development of new programs, and the stimulation of technological developments. One example of such a plan recently published in *Addiction* (Voas et al., 2011) is shown in **Table 1**. That seven-point plan captures many of the current trends in the criminal justice system:

1. The model proposes an expansion of the current emphasis on replacing jail with tightly monitored drinking or interlock programs. There are two clear benefits of this procedure: jail cost savings to the community and less damage to the support systems for the offenders, as they can continue to work and live at home and their innocent family members are less affected. A potential limitation is that, based on deterrence theory, noncompliance must have an immediate, significant, but moderate, sanction. Thus, some use of jail will be required, whereas other sanctions, such as extensions of time in the monitoring program, are not effective.

TABLE 1 Proposed Features of a National Model for the Management of DUI Offenders (Reproduced from Voas et al., 2011)

The emphasis is on replacement of jail with low-cost monitoring programs paid for by the offender.
Sanction alternatives are maximized to increase flexibility in meeting the offender's needs.
Behavioral triage is used to create performance-based sanctions.
Control of consumption is emphasized to impact all substance abuse problems.
Treatment is focused on the offender's needs in meeting monitoring requirements.
Monitoring data are available to enhance offender screening and assessment.
Rapid development of new technologies will increase the requirement for program evaluation.

2. The model also recommends the expansion of alternative sanctions to increase flexibility in handling DUI offenders. Technology has provided an expanded set of options for sentencing DUI offenders. These options can be arranged in severity based on the intrusion they impose on the offender's life. Such a proposed ranking of sanction severity is shown in the left column of [Figure 1](#) taken from Voas et al. (2011). It is topped by jail as the most severe sanction and proposes a downward ordering of sanction programs based on intrusion or level of control of the offender's behavior to the zero point where the operator's license is restored. In concept, moving the offender up or down that ladder of sanctions could be used to sanction noncompliant DUI offenders or to reward those who do comply.

3. Behavioral triage is employed to create a performance-based sanctioning system. Triage procedures currently exist in jail programs based on a reduced sentence for "good behavior." The concept also appears in some state interlock programs that require no lockout performance for a specified time. Given the relatively long list of sanction options available and the ability to extend time in the penalty programs, courts would have considerable flexibility in selection of the programs that best fit the offenders who come before them. That flexibility would allow the courts to initially place the offender in any of the cells in [Figure 1](#), with the possibility of the offender moving to cells involving less intrusion and shorter supervision periods, based on performance (e.g., conformity to program requirements).

4. The major factor underlying all community correction program alternatives to jail is the focus on limiting or preventing drinking or drugging. An important benefit of this approach is that it has the potential to reduce nonhighway alcohol-related injuries, fatalities, and other health problems such as unprotected sex. The extent of such benefits is generally unknown but should be a research priority.

5. A potential feature of the emphasis on monitoring drinking is the development of a more central role for treatment in the management of DUI offenders. Although most court programs require participation in an education or treatment program, except in DUI court

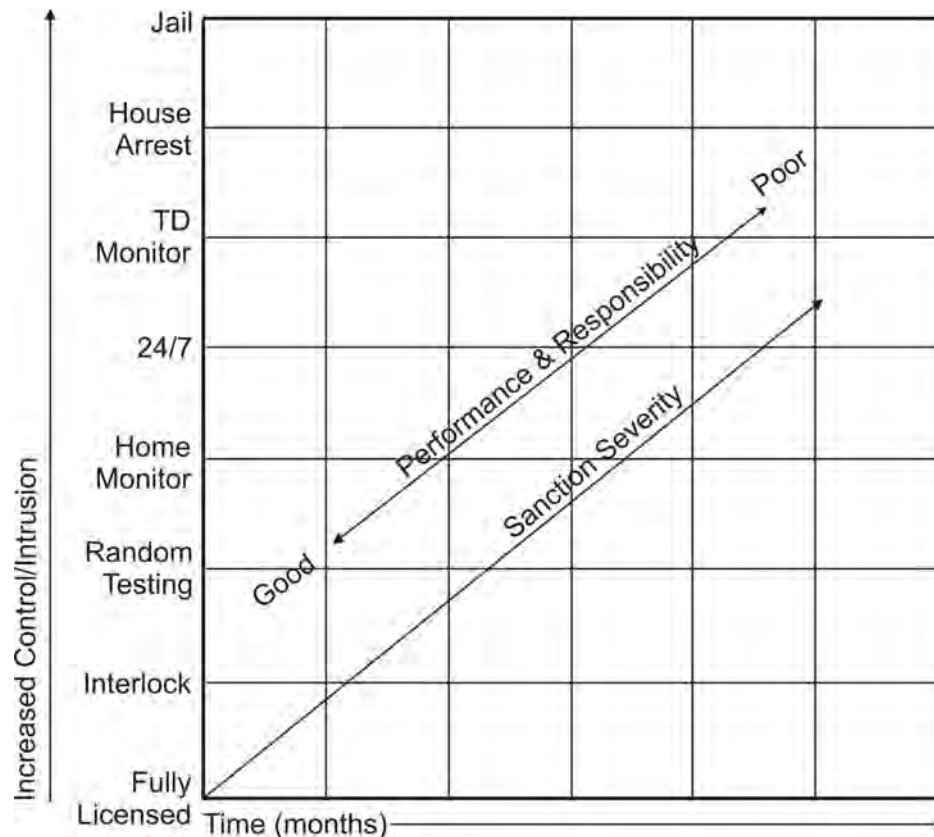


FIGURE 1 National model for managing DWI offenders.

programs, attendance and curricula are poorly coordinated with other sanctions (Voas and Fisher, 2001). When the severity of the sentence is based on the ability to control consumption, offenders may be more highly motivated to seek and benefit from treatment services.

6. The close monitoring required to enforce behavioral triage programs generates a continuous flow of data that can be used in treatment programs to help make therapy relevant to the offender in perfecting problem diagnoses and in detecting relapse. Current screening devices for determining problem status and designing treatment protocols can be enhanced with the information flowing from alcohol consumption measures and with other information on adherence to sanction program requirements.

7. The rapid growth in the application of new technologies and the need to develop measures for use in managing behavioral triage programs will stimulate the need for applied research. Aside from the use of interlocks, most of the new technologies for monitoring alcohol have had only limited, short-term cursory evaluations.

This program concept moves away from reliance on substantial jail terms for multiple offenders and unsupervised license suspension for lesser offenders to a system closely monitored alcohol and drug use. By focusing on the agent producing the highway problem, it offers the possible serendipitous advantage of reducing broader alcohol and drug behaviors and increases the relevance and significance of treatment in the management of DUI offenders. Certainly other conceptions for a national integrated DUI management system are available.

QUESTIONS FOR THIS CONFERENCE

1. **Is a national model useful? Needed?** Certainly, it can be argued that it is beneficial to allow “a thousand flowers to bloom” to spur innovation in the criminal justice and treatment field. However, the limited funds communities have for experimentation constrains the amount of innovation and evaluation that can be financed. A common model followed by all 50 states would provide several advantages. It would help clarify sanction program and treatment program objectives. It would stimulate technological development by creating a national market through which new devices and programs can be disseminated. It would stimulate program evaluation efforts and extend the external validity of research findings to other communities across the nation. A national model would help to better define training requirements for criminal justice and treatment program personnel and would provide the basis for development of a national system for measuring progress in the effective management of DUI offenders.

2. **To what extent are current DUI treatment programs effective?** There has not been a comprehensive meta-analysis of DUI treatment programs since the 1995 Wells-Parker et al. (1995) study. Over the last 15 years, significant developments in treatment methods and new knowledge of the characteristics of DUI offenders have accumulated. Many of the current DUI court intervention programs are based on treatment approaches found to be effective with patients with traditional *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV), diagnoses of dependence and abuse. However, data from the 2007 National Roadside Survey suggest that heavy drinkers, particularly binge drinkers who do not meet DSM-IV criteria, are most prevalent among drivers with illegal BACs (Furr-Holden et al., 2009; Voas et al., 2011). Further, studies based on the Fatality Analysis Reporting System (FARS) suggest that most drinking drivers in fatal crashes are not characterized by DSM-IV alcohol use disorders. This raises the issue of whether traditional treatment methods for DUI offenders are appropriate and whether specialized programs or program elements need to be developed.

3. **Are performance-based sanctions effective?** Based on the demonstration by Marques et al. (2003a; 2003b) that interlock performance while the units are installed is predictive of recidivism following de-installation, several states have passed legislation extending the time on the interlock for offenders who continue to have lockouts. It remains to be determined whether such extensions reduce future recidivism. A similar issue arises in determining the length of time for the application of home confinement or abstinence monitoring. The general issue is to what extent the offender’s performance while being monitoring predicts future behavior.

4. **Is enforced abstinence therapeutic?** All basic sanctions for DUI are based on incapacitation—jail provides the most complete incapacitation, but the others all involve some forced or monitored limit on behavior to prevent recidivism. Interlocks are designed to prevent the impaired driver from starting a vehicle; monitoring drinking is designed to prevent impairment; and license suspension is designed to prevent driving. Evidence has shown that all these sanctions are somewhat effective while in place, but research has failed to provide evidence that any produce effects once the offender has been released from the control mechanism [for examples, see Voas (1986) for jail; McKnight and Voas (1991) for license suspension; and Elder (2011) for interlocks]. With the new means of monitoring abstinence, this general finding needs to be confirmed. If incapacitation controls are only effective while in place, then reductions in injuries can only be achieved by lengthening the sanction programs.

5. How long can incapacitating sanctions be kept in place? The strength of license suspension is that it is inexpensive for the state to impose and maintain. Its downside, of course, is that it is difficult to enforce and therefore its effectiveness is limited. Jail is too expensive for the government and ultimately too damaging to the offender for use over long periods. House arrest and transdermal monitoring are currently too expensive for long-term application. Interlocks and portable breath-test monitoring are two systems that are sufficiently low in cost so they can be paid by the offender over a long time (Voas, 2011). New Mexico is engaged in an experiment involving the long-term use of the interlock through the implementation of a law that specifies 1, 2, and 3 years on the interlock for first, second, and third offenders and lifetime for fourth DUI offenders (Marques and Voas, 2010). Portable monitoring systems that verify the sample provider not only may be the least intrusive, but may also be the most beneficial long-term sanction because they enforce abstinence and thereby reducing all alcohol-related injuries. However, the impact of these systems remains to be demonstrated. Alcohol biomarkers (Marques et al., 2010), particularly if collected in hair samples, provide a time base of up to 6 months and may be a relatively unobtrusive means for long-term supervision.

6. Is enforced abstinence appropriate for first-time offenders without AUD? The application of interlock programs to first offenders has been promoted by MADD and, despite a strong challenge from the alcohol industry, is being implemented by most states based on substantial evidence for its effectiveness with first offenders (Roth, Voas, and Marques, 2007). Issues similar to those surrounding use of the interlock can be expected to arise with the use of alcohol monitoring if it is applied to first offenders with no evidence of a drinking problem. Although a system that prevents drinking should be as effective for first as for multiple DUI offenders while it is in place, it can be argued that controlling consumption is less relevant for non-problem drinkers. However, heavy episodic (binge) drinking seems to be more strongly related to impaired driving than is a DSM-IV diagnosis.

7. Are the beneficial effects of interlocks and monitored consumptions greater than the increased risk due to exposure? The evidence that offenders in interlock programs have lower recidivism than suspended offenders is extensive (Elder et al., 2011). However, offenders in interlock programs are free to drive ad lib; therefore, they are more exposed to non-alcohol-related crashes than fully suspended drivers who tend to drive fewer miles because of concern about being arrested for unlicensed driving. DeYoung et al. (2004) found that offenders in interlock programs had more non-alcohol-related crashes than suspended offenders; however, their level of crash involvement was about that of the average driver. This raises an issue for any countermeasure that prevents drinking while allowing full driving privileges. Is the benefit from the reduction in alcohol-related crashes (which tend to involve more severe injuries) achieved by the program greater than the increase in non-alcohol-related crashes resulting from increased driving exposure?

8. What sanctions are appropriate for crash-involved DUI offenders? Most drivers convicted of DUI have not been in a crash, and their placement in monitoring and treatment programs appears to give courts relatively little problem. However, drinking drivers who are involved in injury or fatal crashes typically receive relatively lengthy jail sentences. This is based on the concept that one function of criminal sanctions is retribution (Ross, 1982). It is also designed to produce general deterrence to impaired driving. Ross and Voas (1990) have pointed to the irony of such severe sentences in that chance plays a major role. Crash-involved drivers may have few differences from other arrestees, but their impaired driving involved a victim

rather than being stopped by a police officer. Research is needed to determine whether DUI offenders exiting prisons need special treatment and monitoring programs.

9. **Can we develop a national measure of program effectiveness?** Tracking progress due to changes in the law is an important factor in policy development. The FARS file has been used in influential studies of DUI law such as the .08 BAC limit and underage drinking laws. The FARS contains a record of prior DUI offenses accumulated over the previous 3 years by drivers in fatal crashes. These data can be analyzed by state, by year, and by BAC at the time of the crash to produce the ratio of drivers with prior DUI offenses to all drinking drivers in fatal crashes. These types of analyses offer the possibility of building a measure of the effectiveness of each state's handling of its DUI offenders.

The proportion of drinking drivers in fatal crashes that have a prior conviction in the last 3 years is highly variable, as shown in **Figure 2** which ranks the 50 states based on the percentage of drinking drivers (BAC > .00) in fatal crashes have had one or more DUI offenses in the last 3 years. Data are based on the sum of the decade from 2000 to 2009. Low percentages of drivers with previous DWI convictions could indicate more effective management of convicted offenders; however, it could also result from a lower DUI conviction rate. Which of these alternatives provides the best explanation for the variation among states will require additional analyses of information on total arrests and conviction rates. **Figure 3** provides a plot of the proportion of drinking drivers who were involved in fatal crashes and had a DUI conviction in the 3 years preceding the crash, based on FARS data from 1982 to 2009. There is an indication that the percentage of drinking drivers with a prior DUI has been falling.

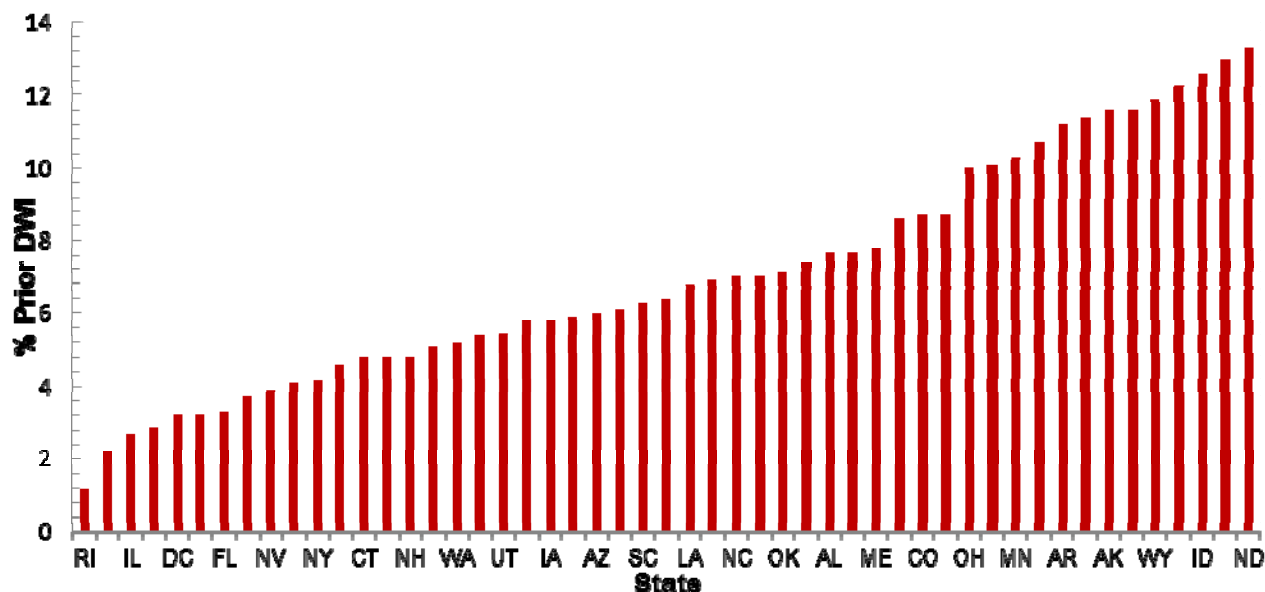


FIGURE 2 Ten-year mean proportion of FARS drivers in 50 states and the District of Columbia with BAC > 0 who also had a prior DWI, 1999–2009.

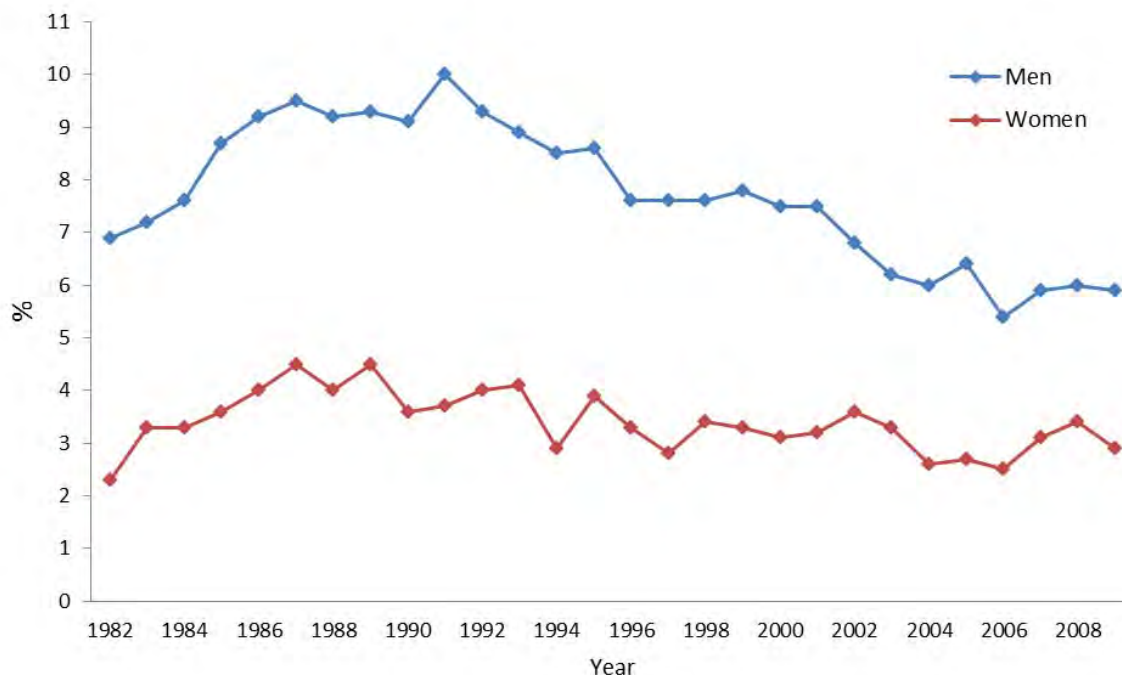


FIGURE 3 Proportion of FARS men and women with BAC > 0 who also had a prior DWI, 1982–2009.

CONCLUSION

Based on the falling trend shown in Figure 3, there is an indication that the management of DUI offenders has become more effective in the past 15 years, a period of rapid growth in the use of ignition interlocks and DUI courts, and the introduction of transdermal alcohol monitoring. Whether those monitoring methods had any role in producing this result is unknown. The downward trend in drinking drivers with a prior DUI contrasts with the measure commonly used to evaluate progress in reducing alcohol related crashes—the percentage of all fatal crashes that are alcohol related which has not changed significantly since 1995. This is not surprising because the percentage of drinking drivers with a prior is probably too small to have a significant impact on the overall percentage of fatal crashes that are alcohol related.

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Controlling the Risk of Impaired Drivers Through Use of Vehicle-Based Sanctions *Impoundment, Forfeiture, and License Plate Sanctions*

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The traditional approach used for decades to mitigate the traffic risk posed by alcohol- and drug-impaired drivers is to incapacitate them through a combination of a relatively brief period of incarceration followed by a longer term of driver license suspension or revocation, while attempting to break their dependence on alcohol by requiring them to attend alcohol–drug education and treatment programs. The logic of this approach is that in the short term, public safety is enhanced by preventing offenders from driving while impaired, while a longer-term solution is pursued by motivating them to resolve their substance abuse problems. Additional control is gained through deterrence, by threatening all drinking drivers with jail and license suspension if they drive impaired (general deterrence), and subjecting those who are apprehended to these sanctions (specific deterrence).

While there is a compelling logical basis to this traditional approach, it has notable limitations. Research on the effectiveness of incarceration for driving under the influence (DUI) offenders has not shown this to be effective in deterring them from reoffending (Tashima et al., 1993; DeYoung, 1997). And while jail terms are completely effective in incapacitating individuals while they are actually incarcerated, the early release of offenders due to jail overcrowding has mitigated the effectiveness of this sanction. Furthermore, even when offenders actually serve their prescribed jail terms, these are often insufficient to yield significant incapacitation effects (Ross, 1992).

Jail incapacitates DUI offenders by physically preventing them from driving. Driver license suspension attempts to incapacitate drivers by denying them the privilege to drive, and while there is a significant body of evidence that it reduces the extent and types of driving (Hagen, McConnell, and Williams, 1980; Ross and Gonzales, 1988), and that it exerts both specific and general deterrent effects (Rogers and Schoenig, 1994; Rogers, 1997; Wagenaar et al., 2007), most offenders continue to drive while under suspension. Thus, while license suspension does have salutary traffic safety effects, it does not fully incapacitate high-risk drivers.

The limited effectiveness of incapacitating and deterring drinking drivers through jail and driver license suspension has led to the exploration of additional measures to better control their driving risk. One class of relatively new measures targets the vehicles driven by impaired drivers. These vehicle-based countermeasures can be classified into three major categories: (a) increase the visibility of the vehicle by confiscating or marking the license plate or the registration tags, thereby deterring the offender from driving it illicitly; (b) physically remove offenders' access to their vehicles by immobilizing, impounding, or forfeiting the vehicle; or (c) allow access to the vehicle but prevent it from being driven by a drinking driver through the installation of an ignition interlock device. This paper will concentrate on the first two categories of vehicle-based countermeasures.

Vehicle-based countermeasures have been used for more than two decades, but were given a boost through the enactment of the federal transportation bill, Transportation Equity Act

for the 21st Century, which was passed in 1998. This bill provided a financial incentive for states to enact either a vehicle impoundment or ignition interlock law, and following its enactment several states passed vehicle impoundment laws. The increased use of vehicle impoundment and vehicle license plate countermeasures has provided the opportunity to conduct evaluations examining their effectiveness, and there is a growing body of evidence that they are an important strategy for controlling impaired drivers (Voas and DeYoung, 2002).

MEASURES THAT INCREASE THE VISIBILITY OF OFFENDERS' VEHICLES

At first glance, it would appear that incapacitating high-risk DUI offenders could best be achieved by physically separating them from their vehicles, either by incarcerating the offender or by removing his access to his vehicle by impounding or immobilizing it. However, there is another set of countermeasures that, while not physically preventing access, makes it more likely that offenders will choose not to drive. This latter set of measures attempts to deter them from driving illicitly by making them more visible to law enforcement if they do so.

Several studies have shown that 75% or more of suspended–revoked drivers continue to drive in violation of their suspension orders (van Oldenbeek and Coppin, 1965; Hagen, McConnell, and Williams, 1980; McCartt et al., 2003; Chang et al., 2011). The Achilles heel of license suspension is that it is difficult to enforce because driving while disqualified is essentially an invisible offense. While DUI offenders with suspended driver licenses may reduce the amount they drive and the way in which they drive in order to avoid detection by law enforcement, they do continue to drive knowing that it is unlikely they will be apprehended and punished.

To achieve better rates of compliance with license suspension orders requires increasing the sense among DUI offenders that license suspension is not just a “paper tiger,” and that violations are likely to be detected and punished. One set of vehicle-based countermeasures attempts to do this by making the invisible offense of driving while disqualified more visible by removing or marking the license plate or registration tags or by providing to law enforcement a list of the plate numbers of offenders' vehicles.

Registration Tag Marking

Two of the first states to implement programs marking the registration tags of vehicles driven by suspended drivers were Washington and Oregon, which enacted laws in 1988 and 1990, respectively. Both states' laws provided for the administrative cancellation of a vehicle's registration at the point a driver was apprehended driving while suspended (DWS). Once a peace officer determined that the driver is DWS, he places a striped tag over the registration sticker on the vehicle's license plate, issues a temporary registration document to the driver, and then mails the original registration to the motor vehicle department.

Voas et al. (1997a) evaluated both the specific and general deterrent effects of Oregon and Washington's registration tag marking programs. Their general deterrence analyses, which used ARIMA models to conduct interrupted time series analyses of monthly rates of DWS violations, moving traffic violations, and crashes, found evidence of a general deterrent impact on two of the three measures in Oregon, but no such impact on any of the three measures in Washington.

The authors posit several possible explanations for their mixed findings. The first is that the target groups were somewhat dissimilar. In Oregon, the law applied regardless of whether the apprehended DWS driver owned the vehicle, while Washington's was more restrictive, allowing the registration tag to be marked only if the vehicle belonged to the offender. In addition, there was evidence that the law was not enforced as strongly in Washington as it was in Oregon; only about one-quarter as many tags were marked in Washington as in Oregon, and while Oregon showed a rise in DWS convictions after the law was implemented, there was no such increase in Washington.

Unfortunately, it was not possible to identify which offenders in Washington actually had their registration tag marked, making it impossible to examine the law's specific deterrent impact there. Thus, Voas and colleagues were only able to study the specific deterrent impact of Oregon's law. Voas et al. (1997a) used a quasi-experimental design to examine whether Oregon's law affected the likelihood that drivers apprehended DWS whose registration tags were marked had fewer subsequent violations (DUI, DWS, and moving traffic) and crashes than similar drivers whose registration tags were not marked. They found that offenders whose registration tags were marked had significantly fewer DUI violations, DWS violations, and moving traffic violations than offenders whose tags were not marked, suggesting that Oregon's law exerted a specific deterrent impact.

License Plate Impoundment

At about the same time Washington was enacting its registration tag marking law, Minnesota passed a law that required drivers with three-or-more DUI violations in 5 years, or four or more in 10 years, to surrender the license plates of all vehicles registered in their names. Due to concern that the law would deprive innocent family members access to the vehicle, a provision was included in the law which allowed the offender to apply for a specially marked license plate that only law enforcement could distinguish as distinct from those normally issued; this special plate highlighted the vehicle to law enforcement and thus provided a disincentive for the offender to drive.

While the original law required judges to order repeat DUI offenders to surrender their license plates at their first court appearance, judges only issued such an order for a fraction of all eligible offenders, so 2 years later the law was amended to make it administrative. This revised law, which required peace officers to seize and destroy the license plate at the time of arrest, was much more successfully implemented than the prior judicial law, with the average number of plate impoundment orders increasing by a factor of 12.

Rodgers (1994) evaluated the specific deterrent impact of Minnesota's plate impoundment law. His quasi-experimental analysis showed no evidence of a specific deterrent impact associated with a judicial plate impoundment order, but he did find that offenders whose plate was impounded by a peace officer or the Department of Public Safety had about 50% fewer subsequent DUI reoffenses than comparable offenders not issued an order.

In 1998, Minnesota's plate impoundment law was extended to first DUI offenders whose arrest blood alcohol content (BAC) was .20 or higher. Leaf and Preusser (2011) conducted a quasi-experimental study of this new component of the law, comparing the rates of subsequent DUI and DWS convictions between first offenders whose plates were not impounded because their arrest BAC was .17 to .19, just below the impoundment threshold, to impounded offenders with BACs of .20 to .22. Their results showed that offenders whose plate was impounded had

approximately 26% fewer subsequent DUI convictions and 38% fewer DWS convictions than nonimpounded offenders. Their findings also showed that the salutary effects of plate impoundment were larger for younger offenders (21 to 34 years), and that a later amendment to the law extending the plate impoundment period from 6 to 12 months did not increase its effectiveness.

License Plate Hot Lists

A similar countermeasure to those discussed above does not physically mark the license plate or registration tag of offenders' vehicles, but instead provides a list of license plate numbers to law enforcement for use in targeted enforcement efforts. California experimented with this as part of a demonstration project designed to increase the detection, prosecution, and adjudication of suspension violators in Ventura County in the late 1980s. To implement this particular component of the overall project, the California Department of Motor Vehicles (DMV) produced a "hot list" of suspended drivers, organized it by the offender's city of residence, and then distributed the list to local law enforcement agencies. DeYoung (1990), who evaluated this demonstration project, failed to find evidence that the hot list led to increased detection of DWS violators, despite reports from some of the participating law enforcement agencies that they used the list and found it useful.

This original hot list was relatively crude, relying on time and resource-intensive computer runs and manual aggregation and production of the hardcopy lists that were distributed to law enforcement. While law enforcement advocates and other safety stakeholders pressed DMV to continue producing the lists following the termination of the demonstration program, it was not until 2010 that advances in technology led to a second, more-sophisticated effort. This second effort, while not formally evaluated, suggests intriguing directions for future work in this area and so will briefly be discussed here.

In this second effort, DMV produced a hot list of all repeat DUI offenders in California that were under an active license suspension action associated with their DUI, updated the list biweekly, and made it available through a secure web-based file transfer procedure to five participating police departments. These departments each had one or two police cruisers that were equipped with automated license plate readers (LPRs) that automatically scan the license plates of nearby vehicles, compares them to the hot list database of license plates provided by DMV, and then alerts the officer if the plate matched one of those in the database.

For the most part, the police departments used the LPRs as a secondary enforcement tool during this pilot program, meaning that they conducted their normal routine patrol and traffic duties while allowing the LPR system to work in the background, following up LPR alerts only as duties permitted. Based on information collected by the five departments during a 6-month period from March through August 2010, approximately 1.3 million vehicle license plates were scanned, and of these there were 2,548 "hits" registered. Because of operational reasons, only 247, or about 10% of these hits were followed up, which resulted in 123 arrests for DWS, two for DUI, and 25 for other violations.

New York also implemented a targeted enforcement effort in 2005 using LPRs to better identify stolen vehicles and suspension violators. Since 2007, the state police, using 100 LPRs, have scanned more than 22 million license plates, resulting in approximately 45,000 vehicle or traffic law arrests, recovery of 212 stolen vehicles, and the arrest of more than 13,000 suspended-revoked drivers (Wyszynski, 2011).

These data suggest that routine patrol and traffic enforcement duties can be successfully supplemented by a LPR and hot list system, and that such an approach can leverage technology to allow law enforcement to better identify the vehicles driven by suspension violators. Whether such a system can exert significant incapacitation or deterrent effects remains to be seen, and further research should be conducted to investigate this. At this point it appears to have the potential to make the invisible DWS offense more visible, and as offenders become aware of this, deter them from illicit driving.

Measures That Physically Remove Access to the Vehicle

The countermeasures reviewed above exert deterrent or incapacitation effects by changing an offender's motivational balance about whether to violate his license suspension order and DWS, but they do not physically prevent the offender from driving his vehicle. The second set of measures discussed below have, in theory, the potential to yield even stronger incapacitation effects since the offender's vehicle is no longer available to him, although they are not foolproof since the offender can circumvent them by simply driving another vehicle.

Vehicle Immobilization

A survey of vehicle immobilization laws enacted throughout the United States found that, as of 2006, 17 states had such laws, although only a few states actively used them (NHTSA, 2008). Although vehicle immobilization is not widely used, Ohio implemented a program in 1993 that was evaluated, and so some evidence exists regarding the effectiveness of this sanction.

Ohio's law targeted DUI and DWS offenders and provided for a graduated period of vehicle immobilization ranging from 30 days to 180 days depending on the offense and the number of priors. Typically, the vehicle was seized by law enforcement at the time of arrest and impounded for a brief period of time pending adjudication of the offense; if the offender was found guilty, the judge ordered that the vehicle either be impounded or towed to the offender's residence and immobilized by placing a club on the steering wheel.

Voas and colleagues (Voas et al., 1997b) conducted a quasi-experimental evaluation of the effects of Ohio's immobilization program by comparing the subsequent rates of DUI and DWS convictions of offenders whose vehicles were immobilized to the rates of offenders whose vehicles were not, due to uneven application of the law. Their results showed that offenders whose vehicles were immobilized had significantly fewer DWS and DUI offenses, with effect sizes of approximately 75% during the time the vehicle was immobilized. The authors also found lower, but still significant, effect sizes (15% to 25%) after the impoundment period ended, although they note that it is not clear whether these represent incapacitation effects or deterrence, since it could not be determined whether the offenders had access to their vehicle. Regardless of the mechanism operating, it is significant that the effects of immobilization extended beyond the termination of the sanction period.

Vehicle Impoundment

Vehicle impoundment has been more widely adopted and used than vehicle immobilization and consequently a greater number of evaluations have been conducted which together provide a more robust evidence base for impoundment vis-à-vis immobilization.

Based on the successful use of vehicle impoundment by the Santa Rosa Police Department and significant media attention to several tragic crashes involving suspended drivers, the California Legislature enacted a statewide vehicle impoundment law that became operational in 1995. This law was administratively applied, requiring peace officers to seize and impound for 30 days vehicles driven by suspended or unlicensed drivers. The suspended driver target group included drivers whose license action resulted from DUI, but also included other high-risk drivers, such as persons suspended for negligent operation of a motor vehicle.

DeYoung evaluated the specific deterrent (1999) and general deterrent (2000) effects of California's vehicle impoundment law. The specific deterrent analysis used a quasi-experimental approach to compare impounded offenders in four jurisdictions with a similar group of drivers in the same cities matched based on propensity scores. The results showed that first DWS offenders who lost their vehicles had significantly fewer 1-year subsequent DUI convictions (24%), moving violation convictions (18%), and crashes (25%) than nonimpounded drivers in the comparison group. Importantly, the results were even stronger for repeat DWS offenders, a typically recalcitrant group, with effect sizes ranging from 22% for moving violations to 38% for crashes. Since data were unavailable for whether and, if so, when offenders retrieved their vehicles, the findings likely reflect a combination of incapacitation and specific deterrent effects.

DeYoung's general deterrent analysis used ARIMA models to perform interrupted time series analysis of monthly crash rates involving suspended drivers, and included as a control series monthly crash rates of nonsuspended drivers. The results showed that, while the crash rates of suspended drivers declined by about 14% after the vehicle impoundment law was passed, the corresponding rates involving nonsuspended drivers dropped by about 8%. Thus, any effects the new law may have had in reducing the crash rates of suspended drivers were small, at best, which the author hypothesized may have been partially the result of relatively little publicity about it.

Ohio passed a vehicle impoundment-immobilization law in 1993. Voas and colleagues examined the effects of this law in Franklin and Hamilton counties, and their results of the effectiveness of vehicle immobilization, which they were able to examine apart from impoundment in Franklin County, were presented above. They were also able to investigate vehicle impoundment separately from immobilization in Franklin County, and their results were similar to those found for immobilization—impoundment was associated with reductions in subsequent DWS and DUI offenses that are both statistically and substantively significant (Voas et al., 1997b).

Voas et al. (1998, 2000) also evaluated the effect of vehicle impoundment in Hamilton County, where only impoundment was used. Their results were similar to those in Franklin County; offenders whose vehicles were seized and impounded had 60% to 80% fewer DWS and DUI offenses compared to similar offenders whose vehicles were not impounded. And, like Franklin County's results, the salutary effects of impoundment persisted beyond the sanction period.

Portland, Oregon, passed a civil forfeiture law in 1989 that allowed vehicles driven by DUI suspended drivers, or habitual traffic offenders (drivers with three-or-more serious traffic offenses, at least one of which is a DUI), to be seized and forfeited. Because peace officers could release vehicles to third parties, such as spouses or lenders, it was possible to evaluate the effects of vehicle impoundment and vehicle forfeiture separately.

Crosby (1995) conducted a quasi-experimental study of Portland's forfeiture law, comparing the subsequent DWS or DUI re-arrest rates of offenders whose vehicles were seized to similar offenders who were arrested for the same offense, but whose vehicles were not taken. The results of the survival analysis showed that offenders whose vehicle was impounded had

significantly fewer DWS–DUI re-arrests than nonimpounded offenders, with effect sizes of about 50%. Crosby points out that the effects he observed likely represent both incapacitation and specific deterrence.

Vehicle Forfeiture

While 30 states have vehicle forfeiture provisions, little is known about how widely it is used (NHTSA, 2008) and, as a consequence, few evaluations have been conducted that can shed light on the effectiveness of this sanction. There is some limited evidence on vehicle forfeiture presented below.

Because law enforcement departments in Portland sometimes released vehicles seized pursuant to the city's 1989 forfeiture law to third parties, it was possible to separately analyze the effects of vehicle impoundment and vehicle forfeiture. Crosby (1995) examined the impact of seizing and forfeiting a vehicle on subsequent DWS–DUI re-arrest rates, and found very similar effects to those of impoundment, with statistically and substantively significant effect sizes in the neighborhood of 50%. His analysis shows that, at least in Portland, there is no evidence that the more severe penalty of forfeiture is more effective in reducing subsequent DUI or DWS convictions than temporarily impounding the vehicle.

During the same session that the California Legislature passed a 30-day vehicle impoundment bill, they also enacted a bill that provided for the seizure and forfeiture of vehicles driven by suspended or unlicensed drivers who had a prior conviction for DWS or driving while unlicensed, and who were also the registered owner of the vehicle. Thus, the target populations of the impoundment and forfeiture laws were basically the same, but the more draconian forfeiture sanction was reserved for the more serious repeat offender.

While California's vehicle impoundment law was widely applied, with more than 100,000 vehicles impounded during the first year the law was effective, only a few jurisdictions used vehicle forfeiture; the paucity of forfeitures—only about 400 were reported during the first year of the law—precluded an evaluation of this countermeasure (DeYoung, 1999).

In 1999, the New York City Police Department began what they termed "The DWI Forfeiture Initiative" by using an existing vehicle forfeiture provision in the city's administrative code to seize and forfeit the vehicles of drunk drivers. The forfeiture was a civil action where the vehicle was seized as an instrumentality of the DUI crime, and this civil action was pursued in tandem with the criminal DUI violation. The DWI Forfeiture Initiative was applied to first and repeat drunk drivers who owned the vehicle, or in situations in which they did not own the vehicle but the vehicle's owner knew that they had a suspended driver license. This forfeiture program has not been formally evaluated; Safir, Grasso, and Messner (2000) reported anecdotal evidence that DUI arrests and alcohol-related crashes decreased after the program was initiated, and that during the first 11 months that the program operated 1,458 vehicles were seized and 827 forfeiture actions were initiated.

DISCUSSION OF VEHICLE-BASED COUNTERMEASURES

There have been more evaluations conducted of some of the vehicle-based countermeasures than there have been of others, and consequently the evidence base for individual measures varies. There have been several well-controlled quasi-experimental studies of vehicle impoundment, for

example, and it is clear that this measure has important traffic safety benefits. At the other end of the spectrum are hot lists used with LPRs, for which the evidence is only suggestive at this point. The weight of all of the current research shows that vehicle-based countermeasures are an important class of sanctions that can reduce disqualified and impaired driving.

This paper has classified vehicle-based measures into those that discourage suspended DUI offenders from driving by making the vehicle more visible to law enforcement if they do so, and those that physically remove access to the vehicle (a third category consisting of ignition interlock devices is the subject of a separate paper). The former set of measures buttresses license suspension orders by making the invisible offense of DWS more visible, thereby increasing the certainty of punishment. The latter set of sanctions doesn't increase the likelihood of apprehension, but instead represents a significant penalty that increases the severity of punishment. Thus, these two classes of vehicle-based measures complement each other in function, so it makes sense to consider combining them as part of a more complete vehicle-based program, and then integrating them with other sanctions that do not target the vehicle. For example, should hot lists used with LPRs prove effective, they could be used along with vehicle impoundment, so that both the certainty and severity of punishment is enhanced.

The choice of which vehicle-based countermeasures to include as part of a complete program should be guided first by evidence of their effectiveness and impact, and then by their operational feasibility and cost. Regarding effectiveness and impact, measures that have a proven general deterrent impact potentially have the broadest reach; unfortunately, few studies have been conducted of the general deterrent impact of vehicle-based countermeasures, so little is known. As discussed above, Oregon's registration tag program had a small general deterrent impact (11% to 13%), although California's vehicle impoundment program did not. Currently, too little is known of the general deterrent impact of vehicle-based countermeasures to predicate a decision based on this. There are theoretical reasons to believe they have the potential to increase general deterrence, but more research is needed.

There is more evidence that vehicle-based countermeasures exert specific deterrent and incapacitation effects, although data limitations in most studies preclude determining which of these mechanisms is operating. Regardless of whether these measures exert significant incapacitation effects, deterrent effects, or both, an important finding is that the beneficial effects extend beyond the period of the sanction itself. For example, Voas et al. (1997b) found that Ohio's vehicle impoundment and immobilization program was associated with significant reductions in recidivism that persisted after the term of impoundment-immobilization, but it is unknown whether this is because offenders failed to retrieve their vehicles due to the high cost (incapacitation), or whether they retrieved them but were deterred from reoffending due to experiencing the loss of their vehicle (specific deterrence).

All of the vehicle-based sanctions reviewed here, with the exception of hot lists used with LPRs, which have yet to be formally evaluated, are effective in reducing DWS and DUI recidivism. While the effect sizes associated with individual measures vary somewhat, all are robust and both statistically and substantively significant. Interestingly, the effect sizes of sanctions that enhance the visibility of the vehicle are of about the same magnitude as those that make the vehicle physically inaccessible; the former range from 26% to 58%, the latter from 18% to 75%.

Given that these measures are all effective, it would be helpful for determining how best to use them if evidence existed showing that they work better for some subgroups of offenders than they do for others. This is difficult to assess, because many evaluations did not examine

sanction effectiveness for offender subgroups, and also because sanction length was sometimes confounded with offender subgroup. For example, while Voas et al. (1997b) show reoffense rates and effect sizes for subgroups of DWS and DUI offenders classified by offense level, the length of the impoundment–immobilization period varied from 30 to 180 days based on offense type and offender level, making it difficult to disentangle the effects of this sanction on different types of offenders from the effects of sanction length.

Despite the paucity of information on differential sanction effectiveness and the need for further research into this topic, two studies do provide some data. DeYoung’s (1999) study of California’s vehicle impoundment law found that the effectiveness of the law in reducing subsequent DWS and moving traffic convictions, as well as crashes, was more pronounced for repeat offenders than for first offenders. This is important, because repeat offenders are typically a recalcitrant group. Leaf and Preusser (2011) found that Minnesota’s plate impoundment law for high-BAC first offenders was more effective in reducing DWS and DUI convictions for younger offenders (21 to 34 years).

Since vehicle-based countermeasures are an effective tool for reducing the crash and traffic violation risk of impaired drivers, an important policy question is how long they should remain in effect. Unlike jail, vehicle-based countermeasures do not typically cost the community much (impounded unclaimed vehicles being an exception—more on this later), so the optimum length of the penalty should be based on the appropriateness of the penalty to the offense and research evidence on the relationship between sanction length and sanction effectiveness.

There is some evidence that when it comes to sanction length, more is not necessarily better. Leaf and Preusser (2011) found that extending from 6 to 12 months Minnesota’s vehicle plate impoundment law for high-BAC first DUI offenders did not make it more effective. Crosby, who studied Oregon’s vehicle forfeiture law (1995), discovered that permanent forfeiture was no more effective than temporary impoundment, although this may partly have resulted from offenders not retrieving their vehicles. As some investigators have suggested (Grosvenor, Toomey, and Wagenaar, 1999; Wagenaar and Maldonado-Molina, 2007) the severity of sanctions (in this case length) appears to matter less than whether they are carried out with sufficient certainty and swiftness.

There is another reason to consider imposing vehicle-based sanctions for a moderate rather than lengthy period of time, and that is to ensure that the punishment fits the crime and that sufficient public and judicial support is maintained. This is particularly true of permanent vehicle forfeiture due to the controversial nature of the government seizing private property. Vehicle impoundment is facing increasing scrutiny and court challenge in California, and questions are being raised about seizing vehicles driven by suspended and unlicensed drivers apprehended at sobriety checkpoints. From a policy perspective, it is arguably better to employ vehicle-based sanctions in such a way that they are certain and swift, but for a moderate period of time; the research evidence, while admittedly limited in this area, supports this conclusion as well.

How do we ensure that vehicle-based sanctions are swift and certain? The most important consideration is to implement them administratively rather than judicially. Rodgers (1994) found that when Minnesota’s vehicle plate impoundment program was changed from judicial to administrative, plate impoundment orders increased from 5% to 64% of the eligible population. Imposing sanctions at the time of court adjudication delays their onset and makes their imposition equivocal, thus weakening deterrence. This holds true for other DUI countermeasures, including another vehicle-based countermeasure, ignition interlock, which is the topic of a separate paper.

In addition to implementing vehicle-based sanctions administratively, it is important to do so in a way that costs to the community are minimized. California's vehicle impoundment law allows law enforcement agencies to charge an administrative fee upon release of the vehicle sufficient to recoup their costs. Unfortunately, some law enforcement agencies have been overzealous in recovering their costs, leading to charges that vehicles are being impounded primarily to fund law enforcement; evidence-based limits on such fees need to be set in law or regulation.

As alluded to earlier, vehicles that are impounded but never claimed run up storage costs that pose a financial burden to the community. As pointed out by Peck and Voas (2002), this burden can be minimized somewhat by holding rapid hearings leading to quick lien sales. This leads to another issue as well: are there advantages to forfeiture vis-à-vis impoundment? It has already been argued that, from a policy perspective, permanent asset seizure poses political risks. In addition, Crosby (1995) found that in Portland, forfeiting a vehicle was no more effective than simply impounding it. While it is difficult to obtain reliable data on the proportion of impounded vehicles that are never claimed, anecdotal evidence shows that in some jurisdictions it constitutes half of all vehicles seized (Peck and Voas, 2002). This suggests that vehicle impoundment acts like *de facto* vehicle forfeiture to a significant extent, perhaps without the same political risks.

CONCLUSION

Vehicle-based sanctions work. Those sanctions that enhance the visibility of the vehicle should be integrated with those that physically prevent access. They should be administratively imposed at the point the offender is apprehended and should remain in effect for a moderate length of time, especially targeting repeat DUI and DWS offenders, including younger ones. Vehicle impoundment should be prioritized over vehicle forfeiture to increase the chance of continued public support, unless future research shows forfeiture to be more effective. A traffic safety case needs to be consistently made to the public and lawmakers that links the sanctions to reduced deaths and injuries, and their attendant human and economic costs, to enhance support for their continued use.

More research is needed about which vehicle-based sanctions exert general deterrent effects; which offenders are most effectively targeted; whether hot lists with LPRs are effective; whether forfeiture is more effective than impoundment, and; the optimal length of time the sanction should be imposed. In order to monitor changes over time, as well as conduct this kind of research, better data needs to be collected and maintained; in California, for example, it is not possible to even determine how many vehicles have been impounded statewide and whether this has changed over time.

A complete vehicle-based program is part of a larger system of sanctions and treatments that dissuade all drivers from driving drunk, incapacitate and deter impaired drivers that are apprehended and punished, and rehabilitate those that are alcohol dependent. No single measure or group of measures, as in the case of vehicle-based sanctions, is a stand-alone solution and those that have a firm evidence base need to be integrated thoughtfully so that they complement each other and not work at cross-purposes. Impaired drivers entered the DUI countermeasure system because they drank and because they drove. Vehicle-based measures address the driving part of the equation and, logically, should be combined with those measures that address the

drinking part by rehabilitating the offender and monitoring their abstinence from alcohol; this should better protect road users in both the near and long term.

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Overview of Effectiveness of Ignition Interlocks

Reflections from the Perspective of Theories of Punishment

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The findings and conclusions in this paper are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.

Sanctions for violations of the law can serve several goals, including retribution, incapacitation, deterrence, and rehabilitation. Programs that require drivers arrested for or convicted of alcohol-impaired driving to install ignition interlock devices on their vehicles have the potential to serve all of these goals (Jacobs, 2003). According to the U.S. Task Force on Community Preventive Services, they also have the potential to make a substantial contribution to improving public health by reducing alcohol-impaired driving at the population level (Task Force on Community Preventive Services, 2011). The characteristics of any given ignition interlock program are likely to play an important role in its effectiveness for achieving these goals.

This paper presents the available evidence on the effectiveness of ignition interlock programs for achieving each of these goals, using the findings of a recent systematic review conducted for the Guide to Community Preventive Services (Elder et al., 2011). It also addresses ways in which various program characteristics may influence effectiveness in each of these areas.

RETRIBUTION

The principle of retribution posits that it is morally correct for transgressions of the law to be punished, and that the punishment should be proportional to the crime. When drivers are mandated to have ignition interlocks installed on their vehicles, this can be considered to be a form of retribution in four ways:

1. The financial burden on the driver,
2. The resulting inconvenience for vehicle operation,
3. The resulting inconvenience for alcohol consumption, and
4. The resulting social stigma.

The perceived severity of these forms of retribution will be a function of the characteristics of the individual offender (e.g., financial resources, social network), characteristics of the program (e.g., costs imposed, duration of required interlock use), and characteristics of the ignition interlock device itself (e.g., ease of use, conspicuousness).

Because ignition interlock sanctions are usually an alternative to other sanctions, it is important to consider their severity not only in the absolute sense, but their relative severity compared to the alternatives. Evidence consistently indicates that voluntary interlock programs have low participation rates when offenders are offered an alternative of license suspension (Elder et al., 2011). Even among a group of offenders with 10-year license suspensions, only 10% voluntarily chose ignition interlocks in lieu of suspension (Marques et al., 2010). This indicates

that interlock installation is considered by many offenders to be a more severe sanction than license suspension.

Although retribution per se is not of direct relevance from a traffic safety perspective, perceptions of the severity of ignition interlocks as a sanction can have several important consequences. First, the belief that retribution should be commensurate with the offense may reduce support for proposed changes in interlock programs if those changes are perceived as making the punishment too severe or lax. For example, some people believe that ignition interlocks should be reserved for the worst offenders and that mandating them for all first offenders is an excessive punishment (American Beverage Institute, 2011; Marques et al., 2010). It may also be important to consider potential influence of perceived severity in other areas that are of direct relevance to traffic safety. For example, as the perceived severity (particularly the relative severity) of interlock sanctions increases, fewer people will participate in voluntary interlock programs and more people will attempt to avoid participation in mandatory interlock programs. Other things being equal, this would diminish the expected population-level effects of these programs on alcohol-impaired driving.

INCAPACITATION

The primary purpose of ignition interlocks is incapacitation, the prevention of an alcohol-impaired driving offender from reoffending while the interlock is installed in the vehicle. The available scientific evidence clearly indicates that offenders with interlocks installed in their vehicles are at substantially lower risk for alcohol-impaired driving recidivism than those who have had their licenses suspended (Elder, 2011; Willis, Lybrand, and Bellamy, 2004).

Figure 1 graphically presents the results of 15 studies reported in Elder et al. (2011), stratified by key study and population characteristics. Methodologically, these studies fall into two categories. Two of the studies (Beck et al., 1999; Voas et al., 2002) took an intention-to-treat perspective to evaluating the effectiveness of interlocks. They evaluated the effects of interlock programs as a whole, combining results from offenders who had interlocks installed (64% and 62% of the intervention groups, respectively) and those who did not. Thus, their results should be considered as providing a lower bound for the effectiveness of interlocks for incapacitation of individual offenders. The first study (Beck et al., 1999) found a 64% relative decrease in re-arrests during the period when interlocks were installed (95% confidence interval: -79%, -37%). The second (Voas et al., 2002) found a 40% relative decrease in re-arrest rates for first offenders ($p = 0.04$), and a 22% relative decrease for repeat offenders ($p = 0.03$) over a follow-up period that extended for several years beyond the removal of the interlock for some repeat offenders (i.e., those whose DWIs occurred early in the study period).

The remaining 13 studies assessed the effectiveness of interlock installation for individual offenders (EMT Group, 1990; Morse and Elliott, 1992; Jones, 1993; Raub, Lucke, and Wark, 2003; Vezina, 2002; Tippetts and Voas, 1998; Voas et al., 1999; Popkin et al., 1993; Marine, 2001; Bjerre, 2005; DeYoung, Tashima, and Masten, 2005; Roth, Voas, and Marques, 2006; Roth, Marques, and Voas, 2007). These studies consistently found that offenders who had interlocks installed in their cars had recidivism rates (i.e., re-arrests) that were dramatically lower than drivers who did not have interlocks installed (median net reduction of 67%; interquartile interval (IQI) = -82%, -50%). As Figure 1 indicates, the distribution of effect estimates was similar for first offenders versus repeat offenders.

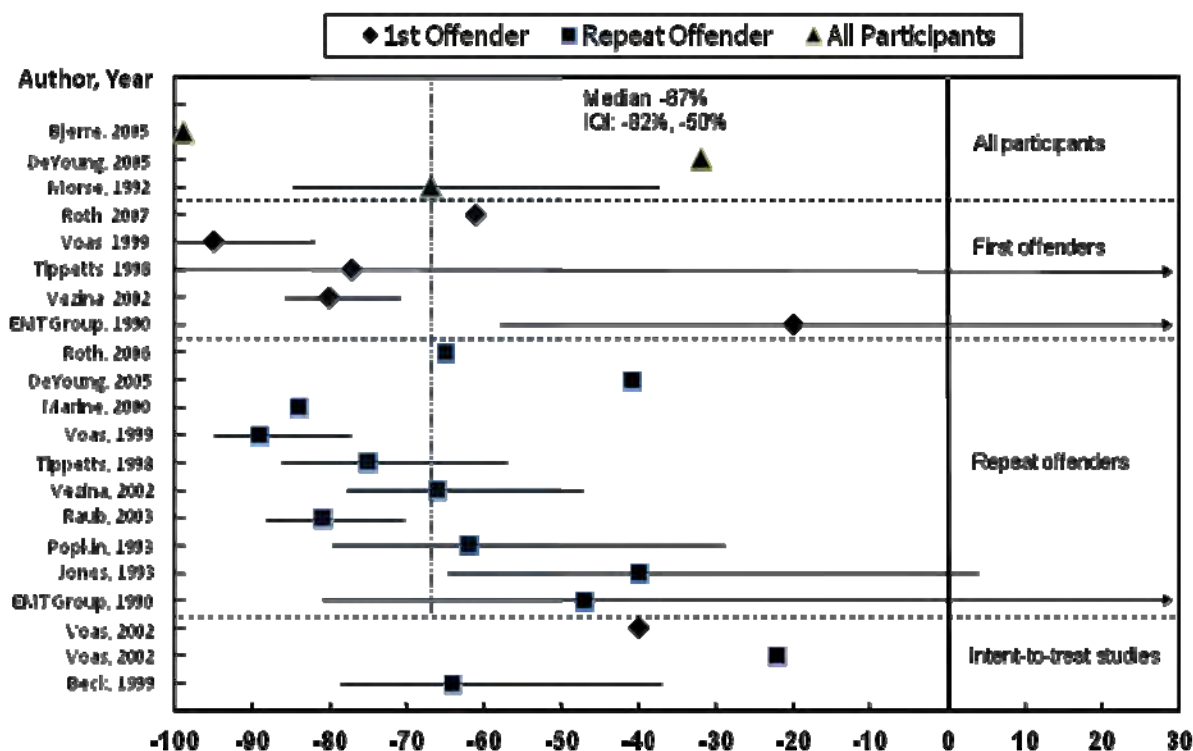


FIGURE 1 Changes in re-arrest rates attributable to ignition interlock installation.

GENERALIZABILITY OF RESULTS

The studies of the effectiveness of ignition interlocks for incapacitation have generally evaluated programs that

- Were applied to offenders who are at high risk of recidivism, either due to multiple offenses or, for first offenders, having had high BAC at arrest (generally >0.15 g/dL);
- Required interlock installation for periods ranging from 5 to 36 months (medians of 7.5 months for first offenders and 18 months for repeat offenders); and
- Were offered as an option in exchange for a reduced length of license suspension (and compared with drivers with suspended licenses as a comparison).

Reported participation rates varied dramatically across the programs evaluated in the reviewed studies, from less than 1% of offenders (Marine, 2001) to 64% of offenders (Voas, Blackman, Tippetts, and Marques, 2002), with a median of 13%. This large variability partly reflects the use of different denominators (e.g., interlock-eligible offenders versus offenders who were actually offered interlocks).

Several studies included evidence suggesting that the offenders with interlocks installed had different characteristics from those who did not. In particular, the interlock groups tended to be older (EMT Group, 1990; Raub, Lucke, and Wark, 2003; Marine, 2001), drive more (Morse

and Elliott, 1992), have higher incomes (Jones, 1993; Marine, 2001), and have more offenses or more serious offenses (Jones, 1993; Bjerre, 2005).

It is important to consider the applicability of the existing evidence for the effectiveness of ignition interlocks for incapacitation to the emerging situation in which (a) interlock programs are being expanded to include a broader scope of participants, particularly first offenders without high BACs, and (b) attempts are being made to increase the proportion of offenders who have interlocks installed. From a theoretical perspective, although several methods of circumvention of interlocks are possible, they all require a substantial amount of effort; the barriers to drinking and driving that they impose apply to every group of offenders. Thus, there is a reasonable a priori expectation that the existing results will apply reasonably well to the current context.

The expectations based on theory described above are buoyed by results from studies in New Mexico, which has been a pioneer in both increasing the scope of interlock programs and increasing participation within eligible groups, support the hypothesis that the effectiveness of ignition interlocks is broadly applicable. One study of first offenders with varied BACs (Roth, Marques, and Voas, 2007; Marques et al., 2010) estimated a 61% lower recidivism rate in the interlock group ($p < .05$), consistent with results for high-BAC first offenders and repeat offenders. A second (Marques et al., 2010) evaluated the effects of interlock installation in a group with very high participation rates (71%) due to the imposition of house arrest as an alternative sanction; this expansion of participation to include people who otherwise may have been resisted interlock installation had no evident influence on interlock effectiveness, with an estimated 62% reduction in recidivism (95% CI = -72%, -48%).

Effects on Traffic Crashes

Although it is well known that people with suspended licenses often continue to drive (McCartt, Geary, and Nissen, 2002), interlock participants who can drive legally appear to make more trips and drive greater distances (Morse and Elliott, 1992). The ability to drive legally can have important benefits to participants and their families with respect to mobility. However, as in all populations, increased exposure to driving is associated with an increased crash risk. Only a small number of studies have examined the association between interlock participation and crashes (Vezina, 2002; Bjerre, 2005; DeYoung, Tashima, and Masten, 2005). These have generally indicated that the interlock groups are involved in more reported crashes than comparison groups with suspended licenses (Elder et al., 2011). However, they may not be involved in more crashes than the general driving population. Although more research on the association between interlock installation and subsequent crashes would be valuable, the pattern of results in these studies is consistent with the relationships that would be expected. Specifically, it appears that the increased driving exposure of interlock participants results in more total crashes than among those with suspended licenses, but that there is no such increase for alcohol-related crashes.

Deterrence

In contrast to incapacitation, which is intended to limit the ability to re-offend, deterrence refers to the potential of sanctions to dissuade people from offending due to their desire to avoid the negative consequences. Deterrence theory posits that the deterrent effect of a sanction will be a function of its certainty, celerity (swiftness), and severity. A further distinction is made between

general deterrence, the deterrent effect on an entire population of knowledge of sanctions, and specific deterrence, the effect of sanctions on recidivism for specific offenders.

In contrast with administrative license revocation, for which there is substantial evidence of a general deterrent effect (Ross and Gonzales, 1987), no evidence is currently available regarding general deterrent effects of ignition interlock programs. A number of studies, however, provide evidence relevant to assessing the specific deterrent effects of interlock installation.

Figure 2 presents the available evidence regarding re-arrest rates in interlock groups following removal of the interlocks, compared to offenders with suspended licenses. Across these studies, there was little evidence that offenders in the interlock groups maintained their improvements in recidivism rates relative to suspended drivers following interlock removal (median effect: -13%; IQI = -31%, 60%). Thus, the results do not support a hypothesis that the ignition interlock programs assessed had a substantial specific deterrent effect. Many allowed voluntary participation, however, making specific deterrence less likely.

It is unclear whether ignition interlock programs contribute to the general or specific deterrent effects of alcohol-impaired driving sanctions. To the extent that such effects do exist, they would be maximized under conditions whereby most offenders have interlocks installed (high certainty) and the interlock sanction is applied quickly (high celerity).

Rehabilitation

The goal of rehabilitation is to design sanctions to address and fundamentally change the underlying causal factors for the offender's behavior. Ignition interlocks have several characteristics that make them a potentially useful tool in the rehabilitation of alcohol-impaired drivers. First, they require an offender to make a choice between drinking and driving, and heavy drinking may preclude them from driving for an extensive period of time. Second, the data they

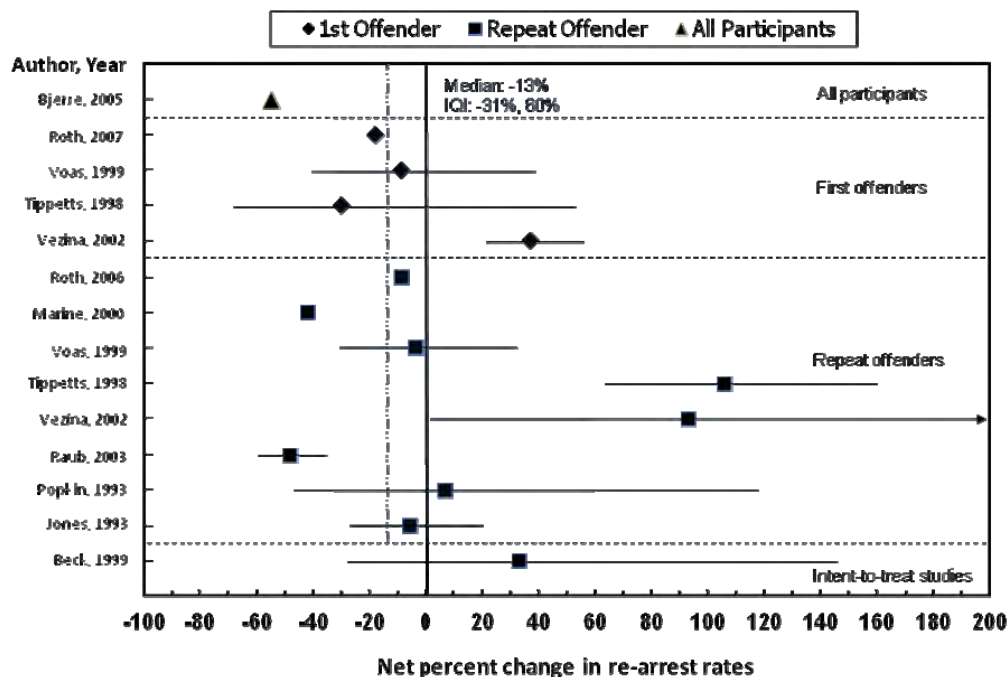


FIGURE 2 Re-arrest rates in interlock groups following ignition interlock removal.

collect on failed starts can provide useful information to guide treatment decisions or trigger consequences for failure to maintain sobriety.

The results in Figure 2 indicate that once ignition interlocks are removed from offenders' vehicles, and thus no longer serve to incapacitate alcohol-impaired driving, their beneficial effects tend to substantially dissipate or not to persist at all. This implies that ignition interlocks by themselves do not generally result in rehabilitation. Studies of programs that have incorporated ignition interlocks and treatment have produced some positive results, however (e.g., Bjerre, 2005; Marques et al., 2007). Bjerre (2005) assessed a voluntary interlock plus treatment program that required participants to commit to sobriety and eliminated those who showed evidence of continued heavy drinking. Participants who completed the program showed substantially lower alcohol consumption and DWI recidivism while on the program, and these improvements appeared to continue during the 2.5-year follow-up period. However, the highly selected nature of the intervention group makes it difficult to identify an appropriate comparison group, and also limits the number of people who may be able to benefit from such a program. Marques et al. (2007) demonstrated that a treatment based on motivational interviewing principles, with counselors following a treatment manual, reduced both self-reported alcohol consumption and failed start attempts.

Voas et al. (2011) have advocated widespread application of an approach modeled on successful alcohol and drug courts to DWI offenders, whereby interlock data can function as a readily available monitoring tool to assess compliance with treatment goals. Under this model, lack of compliance would trigger swift, but modest sanctions, such as very short jail sentences. One major barrier to such an approach is the availability of adequate funds and trained staff. Nonetheless, the potential benefits if successful rehabilitation efforts could be brought to a national scale would be great.

Population-Level Impact

Regardless of the effectiveness of ignition interlock programs for incapacitation, deterrence, and rehabilitation, they will ultimately have little effect on traffic safety outcomes at the population level unless they have adequate scope and reach. One of the most important limiting factors for the public health impact of interlock programs is the relatively small number of offenders who participate in such programs. Despite the continuing growth of interlock use, only a small fraction of the approximately 1.4 million people arrested for DWI annually in the United States use them. This apparently low usage rate is likely due to several factors, including the failure to convict some of the arrested offenders, the policy in most states of confining their programs to the 400,000 to 500,000 multiple offenders apprehended each year, and the opportunity for many eligible offenders to avoid participation in interlock programs.

Among the most important steps that can be taken to address this problem is mandating the use of ignition interlocks for all convicted offenders. As of December 2010, 13 states required interlocks for all convicted offenders. Even mandatory programs, however, often result in interlock installation for only a small proportion of offenders. For example, New Mexico, which has mandatory ignition interlock requirements for all offenders and has made numerous attempts to maximize the number of offenders affected, achieved a 49% interlock usage rate as of the last published report (Marques et al., 2010). Two important determinants for this problem need to be considered: the perceived severity of ignition interlock program participation relative to alternatives and the ease with which the interlock requirement can be avoided.

Two strategies have been attempted to increase the desirability of interlocks to offenders compared to alternatives. First, some states have developed programs that allow or require the installation of interlocks after an arrest (as opposed to conviction) for DWI. This minimizes the period of license suspension during which offenders may become accustomed to driving illegally (McCartt, Geary, and Nissen, 2002); driving illegally without consequences may lead to devaluation of the opportunity for legal driving afforded by the interlock program, and thus increase the desire to avoid participation. To avoid such a situation, Texas has a judicial program that requires some offenders to have an interlock installed before posting bail after arrest. In 2003, New Mexico created a voluntary administrative program that allows any driver whose license is suspended for an alcohol offense to receive a license to operate an interlock-equipped vehicle simply by appearing at the DMV with an interlock-equipped vehicle (Voas, Roth, and Marques, 2005). Second, alternative sanctions can be made more onerous than license suspension, which is the most common alternative to interlock installation. The most tested of these alternative sanctions is electronically monitored home arrest. When this was presented as an alternative to interlock installation in two states (Indiana and New Mexico), approximately two-thirds of DWI offenders chose to have interlocks installed in each instance (Voas et al., 2002; Marques et al., 2010).

Some of the limitations to the scope and reach of interlock programs are inherent in the judicial system itself. In New Mexico, roughly one-third of those arrested for DWI are not convicted of that offense due to acquittal or plea bargaining. Another problem relates to loopholes in the legislation that allow offenders who claim not to have vehicles or who agree not to drive to avoid interlock installation. Those who use this loophole with the intention of driving while suspended can then simply drive an unregistered vehicle or one registered to another person. This “no-car problem” (Roth, Marques, and Voas, 2007) is perhaps the major barrier to extending interlocks to all convicted offenders.

CONCLUSION

First and foremost, ignition interlocks are instruments of incapacitation, a means to prevent a convicted DWI offender from operating a vehicle while under the influence of alcohol. This role should be central in considerations of how to improve the effectiveness of ignition interlocks as a means of improving traffic safety outcomes. The most certain incremental benefits of changes to interlock programs can be gained by increasing the number of offenders with interlocks installed, while taking steps to ensure that efforts to do so do not diminish their effectiveness (e.g., by reducing quality of monitoring). Building a comprehensive rehabilitation program for DWI offenders that incorporates interlocks is also a worthy endeavor that has tremendous potential for a substantial overall impact on alcohol-impaired driving, and is completely compatible with their primary role as an instrument of incapacitation.

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Traffic Safety Impact of Judicial and Administrative Driver License Suspension

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One of the most widely used and extensively studied sanctions to control alcohol- and drug-impaired drivers is the suspension or revocation of their privilege to drive. Driver license suspension attempts to exert a salutary traffic safety impact through both incapacitation and deterrence. In the former, offenders are prevented from engaging in the behavior not by physically separating them from their vehicles, as would be the case for jail, but rather by legally suspending their driving privileges and physically taking their driver license. In theory, we would expect jail to achieve better incapacitation effects than license suspension, although in practice this has not been the case.

In addition to working by incapacitating offenders, there is a potential for license suspension to work through the mechanisms of specific and general deterrence. In the former, the negative consequences of losing their driving privilege would make apprehended offenders less likely to again drive under the influence (DUI) (specific deterrence), while in the latter all potential offenders would be deterred from DUI (general deterrence) due to fear of loss of their license.

Because license suspension has been used for so long and in so many places, there have been many opportunities to study its effectiveness under a variety of conditions which has yielded an extensive evidence base. Due to the difficulties in randomly assigning offenders to license suspension or no suspension conditions, most studies are quasi-experiments, and typically there are self-selection and other potential validity threats that must be ruled out in order for the findings to be interpreted. This being said the studies are sufficiently numerous and varied in design, offender population, time period, and license suspension context that the findings, considered together, present a convincing picture of the impact of license suspension on DUI recidivism.

License suspension was first used as a court sanction, either by judges directly suspending the licenses of DUI offenders at the time of conviction, or by ordering the department of motor vehicles (DMV) to suspend licenses once they were notified of the conviction. Thus, the earliest studies examining the impact of license suspension examined its efficacy in a judicial context.

STUDIES OF JUDICIALLY IMPLEMENTED LICENSE PROGRAMS

California has a long history of evaluating the impact of license suspension as a DUI countermeasure. One of the earliest studies was conducted by Hagen (1977), who compared two groups of drivers, the first comprised of second DUI offenders prescribed a 1-year period of license suspension, and the second group consisting of offenders who would normally have also received a 1-year suspension but did not because their prior DUI conviction was declared unconstitutional and dismissed. Hagen used both matching techniques and covariates in his analysis to reduce pre-existing group differences. His results showed that drivers in the

suspended group, despite having prior driving records predictive of worse subsequent ones, actually had significantly fewer subsequent DUI and reckless convictions, as well as lower rates of injury and fatal crashes, than nonsuspended DUI offenders.

Hagen's 1977 study demonstrated that license suspension, relative to no curtailment of the driving privilege, is an effective DUI countermeasure, but it did not shed light on whether license suspension is superior to alternate sanctions or treatments. He was provided the opportunity to explore this through the enactment of SB 330, which established a post-conviction diversion program in four California counties where repeat DUI offenders could complete a 1-year alcohol program in lieu of license suspension. In comparing the covariate-adjusted outcome measures of alcohol program participants in the pilot counties to matched license-suspended offenders in nonpilot counties, Hagen, Williams, and McConnell (1979) found that offenders in the matched counties had significantly fewer 12-month subsequent total crashes, fatal or injury crashes, and DUI violations, indicating that, as developed and implemented in this pilot program, license suspension was a more effective DUI countermeasure than alcohol programs.

The previous analysis was limited to examining crashes and violations occurring 12 months subsequent to conviction, which may have missed longer-term sanction effects. To examine this possibility, the same offenders were tracked over a 4-year subsequent follow-up period by Sadler, Perrine, and Peck (1991), who found that alcohol program participants had 30% more total crashes and 70% more non-alcohol crashes and convictions than their suspended counterparts. In contrast, alcohol program participants had significantly fewer (9%) alcohol-related convictions; there were no differences between the groups on alcohol-related crashes.

Subsequent changes to California DUI law in the late 1970s and early 1980s expanded the four-county pilot program sanctions statewide, and added a license restriction requirement to alcohol program participation that permitted license suspension to be compared to a less-restrictive option coupled with alcohol program. Tashima and Peck (1986) evaluated this change, and found that second offenders in the suspended group had fewer total crashes and fatal or injury crashes than second offenders receiving alcohol program and license restriction, but that the program and restriction group had 24% fewer subsequent alcohol-related convictions. Tashima and Peck also examined sanction effects for first DUI offenders who received either a 6-month license suspension or a 90-day restriction and alcohol program. They found that offenders receiving alcohol program plus restriction had significantly lower rates of alcohol-related crashes and alcohol-related convictions, but higher total crash rates.

Two subsequent studies conducted in California found results similar to those discussed above. Tashima and Marelich (1989) examined the impact on subsequent crashes and traffic convictions of various court sanctions including jail, fines, license suspension, and alcohol program for first and repeat offenders. Their results showed that, for second DUI offenders, those receiving license suspensions had significantly fewer crashes, but that similar offenders assigned to alcohol programs plus license restriction had significantly fewer alcohol-related crashes and convictions. Similar results were found for first DUI offenders: first offenders receiving license suspension had the lowest rates of subsequent crashes, while such offenders receiving alcohol program plus license restriction had lower rates on alcohol-related crashes. Jail was the least-effective sanction for first offenders.

DeYoung (1997) updated Tashima and Marelich's findings and also examined whether lengthening repeat offender alcohol programs from 12 to 18 months increased their effectiveness. While DeYoung failed to find evidence that the longer alcohol programs were more effective, he did find that combining alcohol program with either license restriction or

suspension resulted in the lowest DUI recidivism rates. And, like Tashima and Marelich, he found that for first offenders, jail was associated with the highest rates of subsequent DUI offenses.

It became increasingly clear from this series of California studies that license suspension was associated with the best outcome on subsequent crashes because it reduced exposure, but that alcohol programs showed increasingly superior effects in reducing DUI recidivism. As a result, these studies consistently recommended that alcohol program attendance include a period of license control. In addition, jail appeared to be one of the least-effective sanction options, at least as implemented in California.

The salutary traffic safety benefits of license suspension found in California are generally mirrored by findings from studies examining the use of suspension in other jurisdictions. Two early studies of license actions in North Carolina evaluated the benefits of suspension vis-à-vis a less-restrictive license action, as well as an against alcohol program. In the first study, Johns and Pascarella (1971) examined a change to North Carolina's drunk driving laws that allowed judges to sentence convicted first DUI offenders to a restricted driver license, with the restriction conditions determined by the judge, instead of the traditional 1-year license revocation. The results showed that the more-restrictive license revocation was associated with lower 1-year subsequent crash rates than license restriction.

The second North Carolina study was conducted by Popkin et al. (1983), who evaluated a statewide program of alcohol and drug education traffic schools for drivers convicted of alcohol-involved reckless driving or a first DUI offense. While this was not a direct evaluation of license suspension versus alcohol program, it compares the relative effectiveness of each measure because most drivers in the program group had much less-restrictive license controls than drivers in the comparison group. The results showed that alcohol program attendees had significantly more subsequent DUI convictions than drivers in the comparison group, which the authors attribute to the loss of deterrence associated with their less restrictive license actions.

Two studies were also conducted of changes to Washington's drunk driving laws. The first provides an indication of the effects of license revocation for a high-risk DUI subgroup, habitual traffic offenders (HTOs), who, as defined by Washington law, were drivers with three or more major convictions, or more than 20 total convictions. Salzberg, Hauser, and Klingberg (1981) examined the subsequent driving records of HTOs who were granted a stay of the 5-year mandatory license revocation by participating in an alcohol program, HTOs who received a revocation, and a control group of drivers. They found that revoked drivers had significantly fewer subsequent convictions and crashes than drivers in the alcohol program and control groups; there were no differences between the groups on subsequent DUI convictions.

In 1980, Washington changed its DUI law by requiring mandatory jail sentences—1 day for the first conviction and 7 days for a second or subsequent conviction—and by establishing a .10% per se provision; the per se component was included to increase the certainty of conviction while the jail requirement represented an increase in the severity of punishment. Salzberg and Paulsruide (1984) compared first and multiple DUI offenders and a control group of drivers convicted before the law change to similar offenders convicted afterwards and found that drivers convicted under the new more-stringent DUI laws had higher subsequent crash and DUI recidivism rates, indicating that mandatory jail sentences appeared to have little incapacitative or deterrent value.

The weight of evidence from these early studies of the traffic safety effectiveness of license suspension clearly shows that it exerts significant beneficial traffic safety effects; it

reduces exposure, thereby attenuating crashes and moving violations of drivers subject to it. It is clearly superior to no license actions at all, and compared to alcohol programs, is more effective as an overall traffic safety measure, although a combination of less-restrictive license controls plus alcohol program appears to yield better control of subsequent drinking and driving. There is little convincing evidence that jail is effective.

However, these early judicial license suspension programs suffered from a significant limitation. Because they were imposed at the time of conviction rather than violation, significant time often elapsed between the drunk driving event and the suspension, and the adjudication process itself introduced substantial uncertainty as to whether a conviction would occur and a suspension action be imposed. This lack of certainty and swiftness in the system meant that individual offenders escaped punishment, and perhaps more importantly, that all potential drunk drivers were less dissuaded from driving impaired than they otherwise would be.

STUDIES OF ADMINISTRATIVE LICENSE PROGRAMS

In an effort to strengthen and improve the effectiveness of license suspension, states began enacting administrative license suspension programs, often referred to as ALS or APS (administrative per se) laws, where peace officers impose the suspension at the time of DUI arrest. These administrative actions do not supplant the post-conviction license control actions, but rather constitute a parallel administrative process to the judicial one, delivering the license suspension action more quickly and surely. In 1976, Minnesota enacted the nation's first APS law, and by the end of 2010 all but nine states had such a law. The effectiveness of APS as a DUI countermeasure has been extensively studied.

Cleary and Rodgers (1986) evaluated a change to Minnesota's APS law, which disallowed DUI offenders to delay the imposition of a suspension action by requesting a hearing. They used interrupted time series analysis to evaluate changes in monthly rates of motor vehicle fatalities occurring during nighttime hours, when impaired driving is most prevalent, and found an abrupt permanent reduction that was significantly greater than that for daytime fatalities, suggesting that a swifter imposition of the administrative suspension resulted in a significant general deterrent impact.

Blomberg, Preusser, and Ulmer (1987) examined the specific and general deterrent effects of a new Wisconsin law that mandated a minimum 90-day license suspension for first DUI offenders. To evaluate the specific deterrent effect of the new law they compared the 1-year subsequent DUI recidivism rates of first offenders convicted the year before the law went into effect with the rates of offenders convicted after the law was implemented; their analysis showed a significant decrease in recidivism associated with the law. Blomberg et al. evaluated the law's general deterrent impact by using interrupted time series analysis to evaluate monthly crashes thought to be alcohol related (nighttime, weekend single-vehicle crashes involving males), finding a significant drop of approximately 25%.

New Mexico enacted an APS law in 1984 which Ross (1987) evaluated using interrupted time series analysis to estimate the law's effect on monthly crash fatalities where either the driver or pedestrian had a BAC greater than .05%. His analysis found a significant drop in such crashes contemporaneous with the implementation of the law of about 10%, suggesting that the law had a significant general deterrent impact. Ross notes that there was relatively little publicity

about the new law, and hypothesizes that its impact would have been greater had it been better publicized.

Oklahoma enacted a number of DUI laws in 1982, including APS. Muller (1989) examined 6 years of monthly fatal crashes using interrupted time series analysis and incorporating in the model data on unemployment and per capita alcohol consumption. He found that while decreased alcohol consumption and unemployment accounted for much of the decline in crashes, the APS and per se laws were associated with a significant drop of about 9%.

Nevada implemented a revised DUI law in 1983 that included APS and a .10% per se standard for legal intoxication. Lacey, Stewart, and Marchetti (1990) used interrupted time series analysis to model data on monthly crashes, alcohol-related crashes, and nighttime crashes occurring between 1980 and 1987 in order to judge the law's effectiveness. They found that while there was a reduction in nighttime crashes associated with the law's implementation, there was no significant change in alcohol-related crashes. A survey of Nevada drivers revealed that awareness and understanding of the new law was limited, so a public information and education (PIandE) campaign was launched. Analysis of the crash series revealed that there was a significant decline in alcohol-related crashes corresponding to the PIandE campaign and a further reduction in nighttime crashes. These results show that APS laws can be effective, but that increasing the driving public's awareness of the law is important to achieve a general deterrent effect.

Rogers evaluated the general (1995) and specific (1997) deterrent effects of California's .08% per se and APS laws that were adopted in January 1990 and July 1990, respectively. To assess general deterrent effects, Rogers used interrupted time series analysis to analyze monthly series of four alcohol-involved or surrogate measures, using non-alcohol crashes as a control, and including additional explanatory variables such as gasoline sales, unemployment, and numbers of licensed drivers. She found that the APS law was associated with permanent reductions in the crash measures ranging from 10% to 16%, depending on the measure. Rogers also evaluated the law's specific deterrent impact by comparing subsequent crashes and convictions of offenders arrested the year prior to the law to those of offenders arrested after the law was implemented. She found that APS was associated with significant reductions in subsequent alcohol-related crashes and DUI convictions among both first and repeat offenders, with effect sizes ranging from 27% to 33% for alcohol-related crashes and 19% to 27% for subsequent DUI convictions.

In addition to evaluating the effectiveness of APS in individual states, the accumulating body of evidence allowed investigators to examine the impact of this measure across states, and to better determine how variation among programs and implementations affected the results. One of the first to do this was Klein (1989), who evaluated the impact of four legislative policies—APS, per se, mandatory jail, and mandatory judicial license suspension—on alcohol-related crashes among states implementing these policies. Klein used interrupted time series analysis to model monthly rates of single-vehicle nighttime fatal crashes per 100 fatal crashes for each state individually, with intervention points set corresponding to the implementation of the four policies. He found that 35% of the 17 states that enacted APS showed significant reductions in alcohol-related crashes, while 29% of the seven states implementing mandatory judicial license suspension showed such reductions. In contrast, only one of the 13 states (8%) implementing mandatory jail sentences demonstrated significant reductions in alcohol-related crashes. Klein's study suggests that license actions appear to be significantly better at mitigating alcohol-involved crashes than jail.

At about the same time that Klein was conducting his evaluation of the effectiveness of APS and other sanctions in individual states, Zador et al. (1988) studied three DUI countermeasures—per se, APS, and mandatory jail—for first DUI offenders implemented throughout the United States between 1978 and 1985. They employed what they termed a “states–pairs” analysis where they examined the effect of the sanction of interest on a series of fatal crash measures, comparing the pre-post change in the state implementing the measure to that of an adjacent state without the measure, and controlling for other potentially confounding factors. Their results showed that only APS significantly reduced fatal crashes overall, but that when subanalyses were conducted that stratified fatal crashes by typical levels of alcohol involvement, all three measures were significant; Per se was associated with significant reductions during times of low to moderate alcohol involvement, APS during times of high alcohol involvement, and mandatory jail for first offenders during times of very high alcohol involvement.

Voas, Tippetts, and Fell (2000) used weighted least squares regression analysis to examine the effect of APS, .10% per se, and .08% per se laws in the United States on the ratio of alcohol-involved to non-alcohol-involved drivers involved in fatal crashes, adjusting for vehicle miles traveled, per capita alcohol consumption, and other potential confounds. They found that all three laws were effective in reducing alcohol-related fatal crashes, with APS showing the strongest effect, with an estimated reduction of 13% to 19%.

Jones and Lacey (2001) conducted a comprehensive, systematic review of the evidence for DUI countermeasures that has been published in the scientific literature since 1990. They reported that there is evidence for the effectiveness of driver license actions in general, and APS in particular, with APS laws associated with reductions in fatal crashes involving alcohol by as much as 40%. They also note that there is conflicting evidence for the effectiveness of jail with some states showing positive results and others showing that this measure is ineffective.

Wagenaar published two articles in 2007, the first detailing the evidence for the effectiveness of driver license suspension (Wagenaar and Maldonado-Molina, 2007a) and the second evaluating fines and mandatory jail terms for first DUI offenders (Wagenaar et al., 2007b). In the first study, Wagenaar and Maldonado-Molina (2007a) examined both pre and post-conviction mandatory license suspension in 46 states, using interrupted time series analysis to create separate ARIMA models for each state, controlling for various potential confounding factors, and evaluating the impact of these sanctions on monthly alcohol-involved fatal crashes occurring between 1976 and 2002. They found that administrative pre-conviction license suspension was associated with a significant 5% reduction in alcohol-involved fatal crashes, but that post-conviction suspension appeared to have little effect, a finding they hypothesize may be due to the speed of punishment associated with the administrative application of this sanction.

In the second study, Wagenaar et al. (2007b) examined the general deterrent effects of mandatory fines implemented in 26 states between 1976 and 2002 for first DUI offenders, and mandatory jail terms implemented in 18 states during the same time period. They used interrupted time series analysis to measure the effects on alcohol-involved crashes of implementing fines or jail, and general linear mixed models to estimate the effects associated with changes in the magnitude of the fine or jail term. Their results showed that the effects associated with these two DUI countermeasures varied widely across states, and that at best there was only weak evidence for the effectiveness of jail (only the pooled effect of 6% on single-vehicle nighttime crashes was significant). Wagenaar et al. summarize their findings by

concluding that there is no convincing evidence that fine and jail have general deterrent effects, especially in relation to APS, which has been shown to reduce alcohol-related crashes.

SUMMARY OF THE EVIDENCE

License suspension has been widely used for a long time, and numerous studies have been conducted of its effectiveness as a traffic safety measure. It works by reducing exposure rather than targeting drinking and driving per se, and the research findings show that it is most effective in reducing overall levels of traffic crashes and convictions. Compared to no license actions at all, suspension is clearly superior, and in general, more restrictive license controls exert stronger effects than less restrictive ones.

However, license suspension is not used in a vacuum, but as part of an ad hoc system of other judicial and administrative sanctions and treatments, so it makes sense to ask about its effectiveness in comparison to alternatives. One of the earliest alternatives for DUI offenders was the requirement that they attend alcohol programs; as described above, the research evidence generally shows that license suspension works better at mitigating overall traffic risk, but that alcohol programs more specifically target and reduce DUI recidivism and alcohol-related crashes.

A more recent alternative to license suspension are ignition interlock devices (IIDs), which incapacitate the driver from driving after drinking by locking the ignition if alcohol is detected on the driver's breath. Since this is the subject of a separate paper little will be said here, except to note that the evaluation findings for IIDs vis-à-vis license suspension roughly parallel those for alcohol programs; interlocks, when installed, are more effective in reducing alcohol-related incidents, but license suspension is associated with greater reductions in overall crashes. As was the case with alcohol programs, since IIDs and license suspension have both been shown to be effective, but in different ways with different outcome measures, it arguably makes more sense to ask how to best integrate license suspension with an IID requirement rather than to focus on which countermeasure should be used.

Another alternative to license suspension, one that physically rather than legally incapacitates drivers, is to sentence them to jail. The evidence for the effectiveness of jail for first and repeat DUI offenders is mixed, at best, with the majority of studies failing to show an association between it and subsequent crashes and traffic violations, relative to suspension and other alternatives. There are a number of reasons for this, chief among them that jail terms for first and second DUI offenders are typically too short to yield significant incapacitative effects, and perhaps more importantly, that many offenders ultimately serve only a portion of the length of their sentenced jail term due to jail overcrowding and related issues.

License suspension was first used in a judicial context, and then later, in an effort to increase the certainty and swiftness of its application, was implemented administratively at the time of DUI arrest. In general, the research evidence shows that suspension is effective in reducing total and non-alcohol crashes when used judicially, and when used administratively, is effective in reducing not only crashes overall, but also crashes where alcohol was a factor. The evidence shows APS exerts both specific deterrent (or incapacitative) effects ranging from 15% to 35% and general deterrent effects of 5% to 40%.

Judicial and administrative license suspension programs have typically targeted both first and repeat DUI offenders, and the research evidence shows that it is effective with both groups.

License suspension has also been used for higher risk offenders, such as HTOs, and evaluations of programs in Washington (Salzberg, Hauser, and Klingberg, 1981) and Oregon (Jones, 1987) show that it can be an effective measure with high-risk chronic offenders.

LIMITATIONS TO LICENSE SUSPENSION

While license suspension is clearly effective, it has limitations. Perhaps its most significant limitation is that it does not fully incapacitate or deter drivers. It has long been known that license suspension is widely violated; a 1965 California study found that 33% of suspended and 68% of revoked drivers had crashes or convictions posted to their driver records during their period of disqualification (van Oldenbeek and Coppin, 1965). Subsequent studies show that as many as 75% of suspended drivers violate their license action and continue to drive, to some extent (Hagen, McConnell, and Williams, 1980; Ross and Gonzales, 1988; Wells-Parker and Cosby, 1988; McCartt, Geary, and Berning, 2003). However, interviews with suspended drivers indicate that they drive less often and more carefully while under suspension in order to avoid detection (Hagen, McConnell, and Williams, 1980; Ross and Gonzales, 1988), which somewhat mitigates their risk. Suspension, however, does not make them safe drivers; a 1997 study by DeYoung and colleagues (DeYoung, Peck, and Helander, 1997) found that suspended or revoked drivers were almost four times as likely as validly licensed drivers to be responsible for a fatal crash.

One key to enhancing the effectiveness of license suspension is to increase the perception among suspended drivers that if they violate their suspension it is more likely that they will be apprehended and punished. Moving license suspension from a judicial to administrative context increases both the certainty and swiftness of punishment, but driving while suspended is still mostly an invisible offense that is difficult to enforce; typically, a suspended driver only comes to the attention of law enforcement if they commit a traffic violation. Increasing the certainty of punishment relies on making this invisible offense more visible through increased enforcement.

One option for increasing the certainty of punishment is to conduct targeted enforcement efforts. There are a variety of ways to do this; one option is to conduct stakeouts of the suspended driver at his home, or at the court following a judge's order to the offender not to drive. Another option is for local law enforcement to contact suspended drivers, either in person or by phone or mail, to let them know that they are aware that the driver is suspended and warning them not to drive. The certainty of apprehension among suspended drivers can also be increased by combining driver license checks with sobriety checkpoints. Sobriety checkpoints have been shown to exert significant general deterrent effects (NHTSA, 2008), and combining them with driver license checks likely exerts similar salutary effects for suspended drivers.

Technology may also help in the detection of suspension violators. One promising measure, outlined in more detail in the vehicle-based paper prepared for this mid-year meeting, is to develop a "hot list" of DUI suspended drivers and use this as a database for automated license plate readers (LPRs), which are typically mounted on law enforcement patrol vehicles. The LPRs, which can be used as either a primary or secondary enforcement tool, automatically scan the license plates of nearby vehicles, compare them to plate numbers belonging to suspended drivers stored in the database, and then alert the officer when there is a match. In a primary enforcement program, the officer dedicates his enforcement efforts to following up alerts and apprehending suspension violators, while in a secondary program the LPRs operate in the

background, with the officer prioritizing his other enforcement duties and only following up potential suspension violators as time permits.

License suspension can be made more effective not only by increasing the swiftness and certainty of punishment for those who violate their license suspension order, it can also be strengthened by increasing the severity of punishment. One penalty that not only uniquely fits the crime but also has a growing body of research pointing to its effectiveness is to impound the vehicles driven by suspension violators. Impoundment has been shown to reduce subsequent crashes and alcohol-involved incidents, as well as driving while suspended convictions among DUI suspension violators whose vehicles are seized (Voas and DeYoung, 2002).

INTEGRATING LICENSE SUSPENSION WITH OTHER COUNTERMEASURES

The key to developing an integrated, comprehensive DUI countermeasure system that effectively mitigates impaired driving is to first recognize it as a system. While the current system (in any given jurisdiction) has evolved not so much as a planned strategic vision, but rather as an ad hoc mixture of interventions undertaken for a variety of reasons, it nevertheless operates as a dynamic system. The addition of sanctions to the mix or changes to existing ones will impact the system as a whole and may change its effectiveness.

Deciding how to best utilize license suspension within the DUI countermeasure system involves a consideration of how suspension, and the other measures, work. As described above, license suspension incapacitates or deters impaired drivers who have been apprehended and also deters all potential drunk drivers from driving impaired in the first place. What it does not do, however, is lessen problem drinkers' dependence on alcohol. This suggests that suspension can be combined to good effect with psychosocial and pharmaceutical rehabilitation efforts, so that public safety is enhanced in the short to medium term, while undertaking a long-term solution that specifically targets offenders' alcohol problems.

It is also important to consider how license suspension and other DUI countermeasures work in order to avoid unintended consequences. One example of this includes efforts to substantially shorten hard license suspension terms to encourage DUI offenders to install an IID. Both license suspension and interlock exert incapacitative and specific deterrent effects, but to date only suspension has been shown to have a general deterrent impact. Shortening license suspension terms too dramatically, while potentially effective in increasing ignition interlock installation rates, runs the risk of undermining the significant general deterrence effect of license suspension and compromising traffic safety overall. What is the most appropriate period of hard license suspension when used with an interlock requirement? Unfortunately, there is not much evidence that bears on this at present, and this is an area where more research is needed. The California DMV is currently beginning a study that will examine the effects of shortening license suspension terms from 12 to 3 months for second offenders who install an interlock, and from 12 to 6 months for third offenders installing a device, but results are still a couple of years away.

Another issue that arises when attempting to integrate license suspension with other DUI countermeasures is that a significant number of suspended DUI offenders do not reinstate their licenses once they become eligible. There are a number of requirements that suspended drivers must meet in order to reinstate, which typically include completing an alcohol program, obtaining insurance, paying fees, and, in some jurisdictions, installing an IID. To the extent that these requirements are directly tied to sanctioning or treating the offender effectively so that they

are less likely to reoffend, or allowing them to monetarily compensate victims should they crash, they make sense and are justified, but for many offenders they represent barriers that they are unable or unwilling to meet. The consequence is that many remain outside the licensing system, some permanently. For example, several studies have shown that one-quarter or more of first DUI offenders and about half or more of repeat offenders do not reinstate their driver licenses within 3 years of being potentially able to do so (Sadler and Perrine, 1984; Tashima and Helander, 1999; Voas, Tippetts, and McKnight, 2010). While there is some debate about whether such drivers present more of a traffic risk by remaining suspended and thus driving less and more cautiously, or by reinstating and increasing their exposure, there is a legitimate question about the wisdom of creating a permanent underclass of deviant drivers whose driving remains out of reach of post-licensing control measures. The temptation to add new requirements that DUI offenders must meet in order to relicense should be tempered with the recognition that it may raise the bar higher and discourage even more offenders from obtaining a valid driving privilege; such new requirements should have convincing traffic safety benefits.

A final issue relevant to using license suspension within the DUI countermeasure system is to consider what it is the system is trying to accomplish. Some DUI countermeasures, such as alcohol programs and IIDs, specifically target alcohol and driving. Others, notably license suspension (and jail, to the extent it works at all), exert broader effects, targeting driving more generally. Is the goal just to reduce DUI recidivism and alcohol-involved crashes, or is it to reduce DUI offenders' traffic risk more generally? There is an argument that at least for some DUI offenders, if not all, mitigating overall risk is an appropriate system goal.

There are several reasons why mitigating the overall traffic risk of DUI offenders through a significant period of hard license suspension may be an appropriate system goal. The first is that license suspension uniquely fits the crime; the system responds to the irresponsible combination of drinking and driving that threatens the safety of other road users by removing the driving privilege. The second reason is that the bottom line in traffic safety is to reduce motor vehicle crashes, which take a huge societal toll in economic costs and human suffering; reducing their incidence should be a high priority and license suspension does this. Finally, a substantial proportion of DUI offenders are risky not just because they drink and drive, but also because they are problem drivers regardless of whether they have been drinking. Arstein-Kerslake and Peck (1985), for example, found two dimensions among which DUI offenders can be distinguished, one representing problem drinking and the other problem driving. Similarly, Hedlund (1994) reviewed the extant literature and suggested that there were three types of DUI offenders: social drinkers, alcoholics, and problem drivers. It is clear that some DUI offenders represent a risk on the roads beyond just driving impaired, suggesting that using license suspension to mitigate traffic safety risk should be an important DUI countermeasure system goal.

CONCLUSION

License suspension works to control the overall traffic safety risk of first and repeat DUI offenders, and when used administratively attenuates alcohol-involved incidents as well. It is used within the context of a system of other sanctions and treatments, and researchers and policy makers should consider broader system effects when implementing new laws or programs or changing existing ones. Its main limitation is that it is widely violated, because it is an invisible offense and is difficult to enforce; enforcement activities that increase the probability of

apprehension and technology that can unmask the invisible nature of the offense will likely increase compliance. Suspended drivers pose a risk on the roads due both to their risky driving and also because there are large numbers of them—more than 1 million in California alone. License suspension should be reserved for serious driving offenses alone (in California, licenses can be suspended for failure to pay child support, graffiti, soliciting a prostitute, and other nondriving offenses) so that it maintains its integrity. Using license suspension in an integrated system involves consideration of how it exerts its effects, its limitations, strengths, and overall system goals. It is relatively inexpensive to administer and is cost-effective, but it does not break the repetitive nature of problem drinking and so should be combined with measures that do. More research is needed on minimum periods of hard license suspension necessary to maintain its general deterrence benefits.

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Technologies to Monitor the Behavior of Alcohol-Involved Drivers

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There has been a bounty of new and innovative developments in technology in the past 10 or more years that, if thoughtfully deployed, could support and extend our continuing efforts to reduce the alcohol road toll in the United States. Some of these technologies have been fully subjected to effectiveness–efficacy research, some partially evaluated, some exist as products in the marketplace but still await evaluation, and other promising approaches are still in development.

In this report, six categories of technologies are discussed, and the evidence bearing on their adequacy and applications is described. Five of these categories represent alcohol-measuring technologies; one category of devices does not measure alcohol but plays a role in constraining the behavior of offenders convicted of driving under the influence of alcohol (DUI). With one exception, all products are directed toward the control of individual DUI offenders, or other types of problem drinkers. A few of the technologies could be configured to extend the monitoring and surveillance of excessive drinking to all drivers, perhaps at relicensing or other encounters. But contemporary practices constrain most opportunities for alcohol detection technologies to the small subset of the drinking–driving population who are arrested and convicted of DUI. Does it have to be that way?

UPHILL STRUGGLE FOR MONITORING TECHNOLOGIES

Although the road safety community makes sustained efforts to communicate the risks of impaired driving via public service messages, policy interventions, and police efforts, the public's desire to reduce the alcohol road toll has to struggle against a countervailing force foisted by the alcohol beverage industry through its lobbyists and media messages. The alcohol industry prefers the idea that outliers, comprised of a hardcore of heavy drinkers, contribute to alcohol road risks; the industry routinely opposes efforts to broaden the focus on alcohol safety interventions to the larger segment of alcohol consumers. Legal scholars Chamberlain and Solomon (2001) addressed this specious argument directly in their paper: *The Tooth Fairy, Santa Claus, and the Hardcore Drinking Driver*. Ten years later, the alcohol industry continues to prefer the idea that alcohol-impaired driving is restricted to a small cadre of bad actors. Today we have ever-more sophisticated alcohol-monitoring technologies available that could help reduce alcohol crash rates, but these are primarily applied to convicted DUI offenders whose alcohol use was significant enough to trigger detection and arrest. The average blood alcohol concentration (BAC) of an arrested DUI offender at .16 g/dL is twice the limit of .08 g/dL identified as impaired in all 50 states.

In recent editorials, alarms were raised by editors at the *Public Library of Science* (2011) and *Addiction* (Stenius and Babor, 2010) about the involvement of alcohol industry's financial

support of scientific research and the growing risk that the industry's influence may bias professional judgments in favor of industry interests. The editors of *PLOS Medicine* ask, "Why are we soft on alcohol?" Health researchers have ample experience with the practices of Big Pharma and Big Tobacco, industries known to advance their views by funding friendly researchers and using this purchased legitimacy to pump up their marketing information with unsupportable claims of benefits or by minimizing risks. The same thing occurs in alcohol research. The distorting impact of alcohol industry money on science and public opinion is reason for concern, and the problem is not restricted to impaired driving; the Global Burden of Disease study, published in the *Lancet*, placed alcohol-related morbidity second only to tobacco in the developed world (Rehm et al., 2009). The Marin Institute in California specifically tracks the industry. The Institute, recently renamed "Alcohol Justice" notes that "...our laser focus is on [alcohol] the world's most harmful drug, and the companies that make and market it."

The alcohol industry has long defended the view that societal alcohol problems are attributable to a troublesome, small, hardcore group of committed drinkers. Big Alcohol develops new products and targets its marketing to attract less wary populations, such as youth and minorities. The availability of potentially harmful products in the marketplace is, under caveat emptor, acceptable; the active promotion of harmful products is contrary to the public interest. Because of these and other potential conflicts of interest for researchers, the *Addiction* editorial recommends that the integrity of alcohol science is best served if all financial relationships with the alcoholic beverage industry are avoided.

According to Williams, McCartt, and Ferguson (2006), the concept of the "hardcore" DUI offender was introduced by the Traffic Injury Research Foundation (TIRF) in 1991, a charitable organization in Ottawa.

In summarizing the initial and subsequent TIRF reports on the hardcore offender, Williams, McCartt, and Ferguson (2006) noted that the concept has been described as people who drive with high BACs and are resistant to behavior change, and are also chronic, persistent offenders. The hardcore concept itself is chronic and persistent. In the years since its introduction, road safety research has failed to support the view that our impaired-driving problems largely result from a small definable core group of drinking drivers. Whatever may be in the hardcore, the impaired-driving problem penetrates out into the shell surrounding it. Defying that view and against industry objections, a few states have successfully introduced first-offender alcohol ignition interlock programs and, in so doing, have widened the definition of the problem population beyond their preferred core. Evaluation studies have shown that the evidence for recidivism reduction with interlocks is as strong with first offenders as with repeat offenders (Marques et al., 2010a; Roth, Voas, and Marques, 2007). Rauch et al. (2010) have demonstrated, based on 5 million driver records in Maryland, that first-time DUI offenders have seven times the number of alcohol actions on their driver record than nonoffenders, but only 25% less than second offenders.

Despite small successes in spreading the potential benefits of alcohol control and monitoring technology beyond repeat DUI offenders (i.e., first-offender interlock programs), such efforts—even if wildly successful—still fail to address the contribution made by the larger segment of the population who drink and drive without arrest or detection. Alcohol-monitoring technologies are still mostly deployed on the few percent of impaired drivers who are eventually arrested. Accordingly, there is a better question to ask than how large is the hardcore.

HOW MANY ALCOHOL CONSUMERS IN THE UNITED STATES?

Grant, Dawson, and Moss (2011) disaggregated data from the large National Epidemiological Survey on Alcohol- and Drug-Related Conditions (NESARC) of adults (age 18+) and produced 12-month prevalence estimates and conditional probabilities of dependence for alcohol, tobacco, and nine types of illicit drugs. (The NESARC is a general population survey in which the subjects are a random representative sample of adults in the United States. NESARC respondents were selected at random from household samples aged 18 or older; the sample—43,093 respondents—can be accurately generalized to the U.S. adult population.) Their projections about alcohol and drug use are based on an estimated 209 million adults in the U.S. population. At the time of survey, they report 65% of U.S. adults consumed alcohol (136 million), and 5.8% of them (7.9 million) met DSM IV criteria (*Diagnostic and Statistical Manual IV* of the American Psychiatric Association) for alcohol dependence during the past year. By contrast, less than 1% of adults (1.6 million) are dependent on all other types of illicit drugs. Based on the NESARC, there are roughly five times more adults in the United States who are more dependent on alcohol than dependent on illicit drugs. Although it is important and worthwhile to estimate and manage the contributions of all impairing substances, the widespread use of alcohol warrants special and sustained attention.

The problem on the road concerns the number of people who place themselves and others at risk due to their use of impairing substances, whether or not they are dependent. With an approximately 20-fold higher prevalence of nondependent drinkers relative to those who are dependent, it is shortsighted to focus excessively on the dependent drinking drivers. Kreitman (1986) showed that while low- to moderate-volume drinkers are more common and have lower individual risk of alcohol-related harm relative to high-volume drinkers, the number of lower-risk drinkers relative to higher-risk drinkers makes that subpopulation a greater contributor to the societal risk. Stockwell et al. (1996) endorse and extend this insight, sometimes referred to as the “Prevention Paradox” which recognizes most of the problems attributable to alcohol are caused by non-heavy drinkers or nondependent drinkers who are episodic binge drinkers (Caetano and Mills, 2011). Binge drinking is defined as “five or more drinks per occasion for males, and four for females.” In a Center for Disease Control and Prevention study of binge drinkers, Naimi et al. (2003) report that 47% of the binge-drinking episodes occurred among self-described moderate drinkers; 73% of all binge drinkers were moderate, not hardcore drinkers.

With 5.8% of drinkers categorized as alcohol dependent by NESARC, by any definition when these people are also drivers, some of these may well serve as a foundational chunk of the hardcore. In a medical context, dependence is the central problem of interest. By contrast in a public health and safety context, the central concern is poor performance, especially driving performance, and public risk exposure to impaired operators. Williams et al. (2006), in a summation of evidence that attempts to extract useful meaning from the hardcore concept, note the difficulty of operationalizing the concept at all. It is either too restrictive if confined to people who are alcohol dependent and too broad if it includes those with a high-arrest BAC. They cite evidence from Wieczorek, Miller, and Nochajski (1992) that 30% of drivers arrested with a BAC >.15 g/dL could not be classified as problem drinkers (much less alcohol dependent). These researchers noted that a one-time measure of BAC is insufficient information on which to make such judgments. However, the problem of insufficient alcohol intake information for judgments about levels of alcohol consumption can be overcome by monitoring technologies that are reviewed in this report. If objective technology-based metrics, which detect patterns of high level

alcohol consumption overtime not just a point in time, could be more widely used, we might be able to reduce the proportion of all operators who drive impaired but without detection.

ALCOHOL-RELATED ROAD RISK

The roadways are the global commons. Unlike in medicine where an intervention is usually focused on an individual, everyone who uses the roads depend on the safe practices of others. We have an incentive to use the best methods of risk surveillance to deliver public safety, just as medical providers would ideally like to use the best practices available to monitor and improve the health of individuals. In both scenarios, best will always have to be defined through some type of benefit–cost calculation for the surveillance methods. In order to target where and how to expend resources wisely, tools are needed to put real numbers on risk estimates.

Before the advent of new alcohol surveillance technologies, most jurisdictions have had to make risk estimates based on past behavior, such as the number of prior DUIs, arrest BAC, moving violations, and other correlates of recidivism. Although it is logical to presume that prior DUI offenders pose greater risk than nonoffenders (and they do), a prior DUI is not always the high-potency predictor it might seem. Based on their analysis of data from the 1992 Fatality Analysis Reporting System (FARS), Hedlund and Fell (1995) reported that only 4% of all drivers in fatal crashes and 11% of alcohol-positive drivers had a DUI in the 3 years preceding their crash involvement. In analyzing 2000–2002 FARS data, McCartt and Williams (2004) reported there were prior DUI convictions for 10% of drivers with BACs of .15 to .19 g/dL, 12% with BACs of .20 to .24 g/dL, and 16% with BACs of .25+ g/dL. Stated conversely, 84% of drivers with an arrest BAC of .25 or were nonoffenders at the time of arrest. The findings from another study of fatal crashes in 1998 by Jones and Lacey (2000) reported only 3.3% of drivers had a prior DUI. Tashima and Helander (1998) found that only 8% of the 810 alcohol-involved fatal crashes in California in 1997 involved a driver with a previous DUI. These numbers demonstrate that (*a*) if prior DUI is a key measure of the problem, it fails to account for about 85% of the fatal alcohol crashes and (*b*) because nearly all alcohol-impaired drivers have driven impaired previously, we do not find and arrest very many impaired drivers.

Without a doubt and by definition, a DUI conviction is a near 100% high-specificity indicator of alcohol-related road risk, but it is an extremely insensitive indicator of the actual problem, which is impaired driving not DUI arrests. Millions of impaired-driving episodes go undetected annually. For example, using the Borkenstein et al. (1974) methods, Miller, Spicer, and Levy (1999) estimated that nationally, in the early 1990s, there were about 1,700 noncrash episodes of impaired driving for each arrest. In a study of a high-enforcement effort in Stockton, California, Voas and Hause (1987), using different methods, estimated one arrest for about 300 episodes of impaired driving. Miller, Spicer, and Levy (1999) estimated that 1 mi of every 75 mi driven in the United States in 1992–1993 was with a BAC $\geq .10$ g/dL; they found the rate was 10 times higher on weekend evenings. They further estimated that the average kilometer driven by someone with a BAC $>.08$ g/dL exceeded \$3 in social costs (cost estimate based on 1995 dollars for medical, police, crash, and direct expenditures), whereas each sober kilometer driven costs about 7 cents. The cost ratio is about 45:1. If an argument for reducing alcohol-impaired driving could be based solely on a cost accounting independent of family traumas, it would still be possible to make a valid case for investing in more widespread screening of drivers, independent of arrests.

Based on FARS fatal crash data in 2009, the situation is improved but not improved enough. More sensitive predictors of impaired-driving proclivity might improve the alcohol risk monitoring of drivers. Prior DUI, arrest BAC, age, and gender continue to be important predictors of DUI recidivism, but they do little to improve detection in real time or independent of police action.

More widespread use of monitoring technologies is a larger and different problem than how to make the best use of technology today for managing DUI offenders. Even if we apply our technologies only to drivers already convicted for DUI, it can still potentially reduce the public risk exposure. Traditional DUI risk indicators can now be supplemented by more sensitive predictors of driver alcohol risk. The more widespread use of newer monitoring technologies might help reduce the cycle of DUI catch and release by improving on the evidence needed to make data-driven estimates of risk likelihood before DUI offenders are released into the general driving public.

MONITORING METHOD 1: ALCOHOL INTERLOCKS

Interlocks Controlling DUI

The alcohol ignition interlock has been well studied and its benefits in temporarily reducing recidivism while installed have been thoroughly described (Beck et al., 1999; Marques et al., 2010a; Roth, Voas, and Marques, 2007; Voas et al., 1999; Willis, Lybrand, and Bellamy, 2004). There are at about 15 studies in the published literature. Across studies, recidivism is reduced by approximately 64% relative to noninterlock offenders during the installed period, but there is little carry-over deterrence into the post-interlock period. More precisely, in most studies the separation of recidivism rate curves (between interlock and noninterlock groups) at the end of the interlock or an equivalent period do not close but do not grow larger either. Studies comparing interlock groups with noninterlock offenders are usually based on groups matched on prior DUI, arrest BAC, gender, age, and sometimes a few additional variables. Beck et al. (1999) reported results from a random assignment design that proved largely similar to the statistically controlled studies. This is not the place for a duplicative review of interlock research as several review papers are available; nearly all describe a convergence toward a temporarily beneficial effect of the interlock while installed (Elder et al., 2011; Marques, 2009). Interlock effectiveness studies often focus on the constraining effect: the interlock's ability to control the behavior of the offender. Zador et al. (2011) have recently shown that the extent of an interlock program's control depends on the extent of active monitoring of the program by the responsible authority.

Zador et al. (2011) of Westat demonstrated that there is better adherence to interlock program expectations when the monitoring authority actively communicates with the interlock-stipulated offenders. In their study, communication was initiated when a participating offender failed to fully comply with the program rules (e.g., marked by failed BAC tests, failure to perform requested tests); in such cases, a warning letter was sent to the offender describing the nature of the violation and the possibility of additional sanctions. On the other hand, offenders were also issued congratulatory letters when a month of data in the interlock log file showed no violations. The metric they used for defining compliance was based on rates of BAC test failures, as well as rates of various procedural violations. More attentive, or closer, monitoring was found to improve compliance with the interlock program rules. They have not yet addressed whether

this closer monitoring had a beneficial effect on recidivism after the interlock, but their work demonstrates one of the ways in which the logged data in an interlock device event recorder can be used to achieve a higher level of compliance with the program expectations.

Interlocks Predicting DUI

Studies of the interlocks' controlling or constraining effect on behavior are one aspect of interlock interventions that warrant attention. Another line of interlock studies are directly germane to the topic of monitoring; these involve the use of interlock BAC test failure rates as advance predictors of future recidivism and, as such, bring an effective way to monitor the alcohol-use proclivities of interlock-stipulated offenders while they are still enrolled in interlock programs. These types of studies complement the interlock's ability to control offenders with an ability to predict their future behavior.

Research at the Pacific Institute for Research and Evaluation (PIRE) has demonstrated that the higher rates of failed BAC tests relative to total BAC tests performed are associated with higher future recidivism. This evidence has been derived from research studies in Alberta and Québec, Canada, and New Mexico; together, this conclusion is based on approximately 35 million BAC tests of 15,000 interlock-using drivers (Marques et al., 2001; Marques, Tippetts, and Voas, 2003; Marques, Voas, and Tippetts, 2003; Marques et al., 2010a). All those studies have been conducted with convicted DUI offenders who use an interlock as part of a license restitution process. An illustration of the basic relationship is found in **Figure 1**, which combines data from the two larger study samples in New Mexico and Québec that together constituted about 13,000 interlock offenders. Ten decile groups (of equal sizes) of interlock users are sorted into those with increasingly higher rates of failed BAC tests (e.g., decile 1 low, decile 5 middle, decile 10 high) during the interlock period. The y axis of Figure 1 shows the recidivism rates 24 months after the interlock was removed, whereas the x categorical axis is defined by the deciles representing BAC failure rates years earlier while on the interlock. The trend was similar in both jurisdictions. Each of the Québec deciles represent about 720 offenders (total $N = \sim 7,200$), and each of the New Mexico deciles represent 580 offenders (total $N = \sim 5,800$). In New Mexico, the lock point is .025 g/dL, whereas in Québec the interlock is set to lock at .02 g/dL. New Mexico had nearly 40% of offenders with zero failed BAC tests, so for direct comparison, the first four deciles from both studies are represented with a single bar.

The predictive profile available through examination of the interlock BAC tests was found to be a sensitive indicator of problem likelihood, often more than variables derived from driver records, and always when an interlock user is a first offender with no prior DUI events on the driver record. A reason in favor of using the interlock BAC test record is that it is a better estimate of the problem we are attempting to solve: alcohol-impaired driving more so than future DUI. DUI arrests and higher-BAC arrests, though highly specific problem indicators, are low-sensitivity estimates of the larger drinking-driving problem. As the impaired-driving prevalence studies by Miller et al. (1999) and Voas and Hause (1987) cited earlier show, arrests interrupt an estimated 0.06% to 0.3% of the episodes of impaired driving, in either case well less than 1%. These low rates of capture do not create a very strong disincentive for impaired driving.

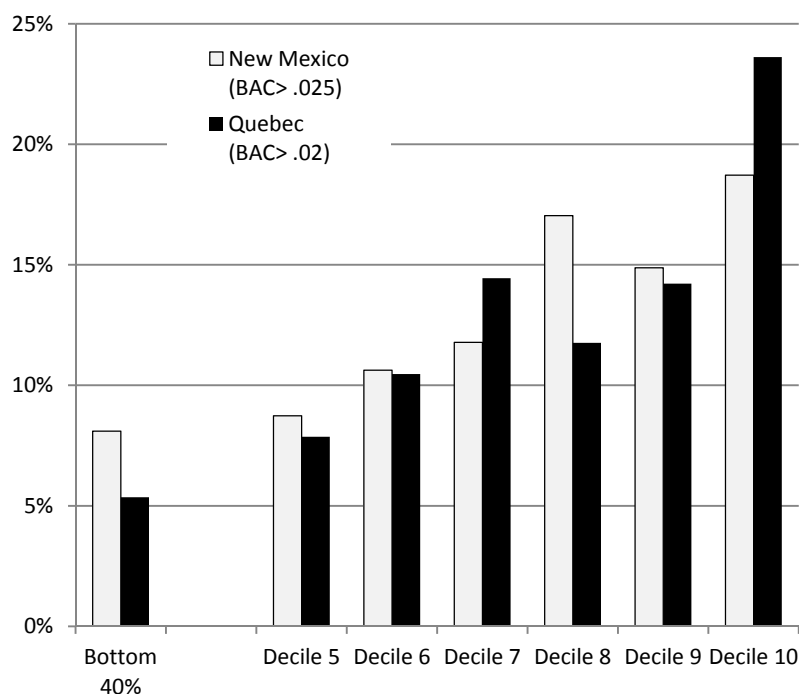


FIGURE 1 Recidivism rates 24 months after interlock removal by deciles of failed BAC test rate during the interlock control period. (Data from Québec, Canada, and New Mexico.)

Attempting to start a vehicle with an elevated BAC has both face validity, and as recidivism studies have shown, predictive validity (even after controlling for other demographic and driver record variables). Unfortunately, by applying this predictive metric to interlock-stipulated offenders (those who are part of the small percentage of drivers who have already been captured and convicted), we can at best help to plug the leak after the fact. But even that is worth attaining.

Someday there may be better alcohol monitoring of the traffic stream independent of arrests and convictions (sobriety checkpoints or random roadside BAC testing) or alcohol monitoring endogenous to new vehicles we purchase and drive. While there is effort underway to achieve those objectives, they are unlikely to come quickly or easily, especially with the alcohol and beverage service industries enjoying decades-old tax rates (= ~58 cents/gal in federal taxes and a dime or two in state taxes; Marine Institute: www.marininstitute.org/site/) and have ample funds to influence public opinion to keep it that way.

Are very many states using the data in the interlock-recording devices to help adjust license restitution decisions? More states are doing this all the time, but anecdotal evidence suggests many states do not mine the interlock BAC record for evidence of an interlock driver's threat to the driving public. PIRE is studying this topic with support from NHTSA contract funds. Even if more states begin to more actively extract information from the interlock record, it might still prove inadequate. Although the interlock BAC data are predictive of future DUI at the aggregate level, an inherent problem with overreliance on the interlock BAC test patterns is that

the interlock is a vehicle sanction and the data might fail to be as useful at the individual level. The veracity of the interlock record assumes that the offender of interest is (a) the one who provides the BAC tests that are logged and (b) the offender being controlled uses the instrumented vehicle rather than a family member.

In practice, the first problem is often overcome by monitoring authorities informing an offender that he is responsible for all the BAC tests on the device. This is often done now in many states; another method is the use of camera-equipped interlocks. In states or courts that want to use these more advanced interlocks at marginally higher cost, the facial image of the breath-test donor is stored with the test result—major interlock suppliers all seem to either have or are planning to have photo-capture interlocks. Other than its deterrent effect, the benefit of this also requires the assumption that some authority actually looks at those images. If done on a selective basis for specific events of interest, rather than a routine basis, it is a reasonable approach. An alternative to visually scanning photographs is face recognition software that can digitize and later recognize the face of specific individuals; a Chinese-manufactured prototype was demonstrated at a recent research meeting. Evaluation studies with either of these methods have not yet been reported, but either method has the potential to personalize the interlock data to a specific offender. A second, possibly larger, problem is to know whether the BAC interlock test record even reflects a particular offender's use of the interlock vehicle. Although this would probably not be a problem for facial recognition software, it could be difficult for photo-capture approaches to documentation if it was later necessary to scan the majority of the photos, not just one or two exceptional episodes.

These developments are interesting and important, but require some caveats. It might be a problem if the monitoring authority relied too heavily on the interlock record as a basis for judgments about driver fitness. If the question is whether a person continues to drink alcohol, a better technology is the use of alcohol biomarkers. These are specific to each individual, require no assumptions about vehicle use, and can be used to determine recent drinking or long-term drinking.

MONITORING METHOD 2: ALCOHOL BIOMARKERS

For reasons that are not clear, few if any North American states or provinces routinely use the measurement of alcohol biomarkers to aid in license restitution decisions for drivers with a DUI conviction. In contrast, many European nations (e.g., France, Germany, Finland, Luxembourg, Netherlands, Norway, Sweden, and others) routinely use alcohol biomarkers as a decision aid. Alcohol biomarkers, which are of different types and can be measured in several different body matrices (e.g., blood, hair, urine), extend the surveillance window and allow for more evidence-based judgments about the extent to which a driver has gained control of his or her alcohol use. Providing samples of body fluids or hair is certainly a reasonable request to ask of someone who has already proven to be willing to operate while impaired and has been convicted for DUI.

Compared to non-alcohol drugs and drug metabolites that affect behavior, the half-life of alcohol in circulation is very short; alcohol biomarkers can extend the detection time frame. Depending on the marker and the matrix used, the surveillance window can be extended for a couple of days, weeks, or even months of past alcohol use to suit different questions of interest. Although the measurement of BAC per se is fine for addressing questions of current impairment, knowledge of the current presence of alcohol in circulation is inadequate to address questions of

the extent of drinking and whether it might pose a public safety risk. The metabolism of alcohol itself proceeds at a predictable average rate of about .017 g/dL per hour. A person could easily drink to the BAC of an average arrested DUI offender (i.e., .16 g/dL) in the evening and be able to blow a zero BAC 10 h later the next day. Even brief alcohol biomarkers, such as ethylglucuronide (EtG) measured in the urine, could extend that detection window to at least 24 or more hours. Before restoring driving privileges, periodically taking confirmatory blood or urine samples to determine drinking status would not represent a large deviation from current practice because the measurement of non-alcohol drugs in blood or urine (e.g., cannabinoids, cocaine, opiates, and their metabolites) is often performed to help answer questions about fitness to drive.

There are two general types of alcohol biomarkers: direct and indirect. Direct markers more directly reflect consumption and indirect markers reflect bodily changes that occur after regular repeated use of alcohol. Direct markers are usually products of minor ethanol metabolic pathways or are formed only in the presence of ethanol. Examples include ethanol itself, EtG, phosphatidylethanol (PEth), and fatty acid ethyl esters (FAEE). All of these have excellent sensitivity and specificity, directly reflect levels of consumed alcohol, and can persist for days or weeks longer than ethanol, or months longer for the markers that can be retrieved from hair. Clinical studies and the basic science can be found in any of several papers or reviews (Aradottir et al., 2006; Høiseth et al., 2009; Litten, Bradley, and Moss, 2010; Wurst et al., 2010). Direct markers can be measured in blood, hair, or urine. EtG measured in urine or blood adds only about 1 or 2 days to ethanol detection, whereas PEth, especially when found in heavy drinkers, can take weeks to fall to zero following drinking cessation (Wurst et al., 2010). When measured in hair samples, EtG provides a long-term exposure indicator (Pragst and Yegles, 2007) and can serve as an objective alternative to confessional estimates of historical alcohol use. Recent data show EtG in hair to be a stable indicator of alcohol use over several months (Agius et al., 2010; Høiseth et al., 2009; Liniger, Nguyen, and Friedrich-Koch, 2010) and is now available in Germany as a legal alternative to more conventional alcohol markers from urine or blood for assisting in driver fitness judgments (Dufaux, 2011; Schubert and Mattern, 2011). PEth is formed in cell membranes and is an exclusive product of ethanol and the membrane enzyme phospholipase D. No alcohol, no PEth; it is undetectable in abstainers or light drinkers. Regarding PEth, Marques et al. (2010b) reported PEth to be the alcohol marker, among nine others, with the strongest intercorrelation with all other alcohol markers. The PEth levels strongly discriminated three risk groups of drivers based on the rates of failed interlock BAC tests. Also, PEth was the one marker (among 10 total) with the strongest parametric and nonparametric correlations with psychometric assessments collected from the sample of DUI offenders.

If the U.S. states were to emulate the most common alcohol biomarker practices by driver licensing authorities in the European Union, the markers to use would be carbohydrate deficient transferrin (CDT) or its derivative, %CDT, and gammaglutamyltransferase (GGT). Both of these can be considered indirect indicators of drinking and are most useful when asking questions about longer established patterns of alcohol use. CDT, for example, elevates after a week or more of consuming at least 60 g of ethanol daily (~ five standard drinks). Indirect alcohol markers are often thought to be indicators of alcohol disease and, above certain levels, are often used to mark alcohol dependence by clinical researchers. Licensing authorities in European nations that rely on alcohol markers most often want to see evidence of drinking cessation before judging someone fit to drive.

Although some of the indirect blood alcohol markers are either insensitive or nonspecific, GGT and CDT may be the best in this category. GGT is a liver enzyme that is often elevated after chronic alcohol consumption, but it is best when used in combination with other markers as its levels can be affected by diseases unrelated to alcohol use (e.g., biliary disease, hepatitis C). CDT, however, is quite specific to alcohol use. CDT is an iron transport protein that has lost some of its carbohydrate containing sialic acid end groups because of regular ethanol exposure; the amount of carbohydrate deficiency strongly reflects ethanol exposure. The transferrin molecule begins to become carbohydrate deficient after a week or more of regular consumption of about 60 g ethanol per day. The relative percentage of carbohydrate deficiency (%CDT, the ratio of CDT to total transferrin), even more so than total CDT, is recommended by an international working group (Jeppsson et al., 2007) as a way to overcome some gender-related variation that is uncontrolled when measuring total CDT. Indirect markers often decline within a few weeks after alcohol use ceases (Jones, 2008). In the United States, the Food and Drug Administration has approved use of %CDT as a marker of heavy alcohol consumption (Litten et al., 2010) in general medicine, and GGT is a standard liver enzyme measured by all clinical laboratories. There is a very large body of treatment research literature on the use of these markers, and several road safety research studies using GGT and CDT have been published as well (Appenzeller et al., 2005; Gilg, Buchholtz, and Huth, 2000; Gjerde and Morland, 1987; Portman et al., 2010).

Although there are several other indirect markers, GGT and %CDT have acceptable to good specificity (CDT much better) and moderate sensitivity. Sillanaukie and Olsson (2001) demonstrated that a log combination of GGT and CDT ($1.3 * \ln \text{CDT} + 0.8 * \ln \text{GGT}$), that they dubbed gamma CDT or γCDT , provides a better estimate of alcohol exposure than either marker alone. Later, Antilla et al. (2003), also in Finland, reported that the log transformation formula also works with %CDT and GGT to yield $\gamma\% \text{CDT}$. Berner et al. (2006), in a large German study, found distinct advantages to combining the GGT and %CDT markers to improve sensitivity, especially for women. As with Antilla et al. (2003) and Berner et al. (2006), Marques et al. (2011) found the combined marker, gamma %CDT ($\gamma\% \text{CDT}$) to have higher predictive validity of detecting a high-risk group in an interlock DUI sample than did either marker alone.

Marques et al. (2010b) evaluated the biomarker levels of 287 interlock-using DUI offenders on the basis of three differing rates of failed BAC tests. Risk categories were defined as the 27% who had zero failed BAC tests, the 53% with a low level of failed BAC tests, and the 20% with a high rate of failed tests. The definition of the zero fail group is simply no failed BAC tests; the classification break point for low and high fail rates was defined by a discontinuity in the data series. This study was done in Alberta, Canada, and so the interlock BAC test failures in this case were defined as tests greater than or equal to .04 g/dL (the province lock point) when attempting to start a vehicle. The 20% of the sample with the high rates of failed BAC tests were found to have had significantly ($P < .0001$) higher levels of alcohol biomarkers at program entry, including GGT, %CDT, $\gamma\% \text{CDT}$, and PEth (Marques et al., 2010b, 2011). Five of six other markers were also significantly elevated. **Figure 2** demonstrates this relationship using Z scores so the four markers can be represented on a common chart. The analysis of variance (ANOVA) *F* ratios associated with the group differences for GGT, %CDT, $\gamma\% \text{CDT}$, and PEth were, respectively, $F = 10, 9, 22, 35$. Post hoc testing determined that the high-risk group accounted for all the differences.

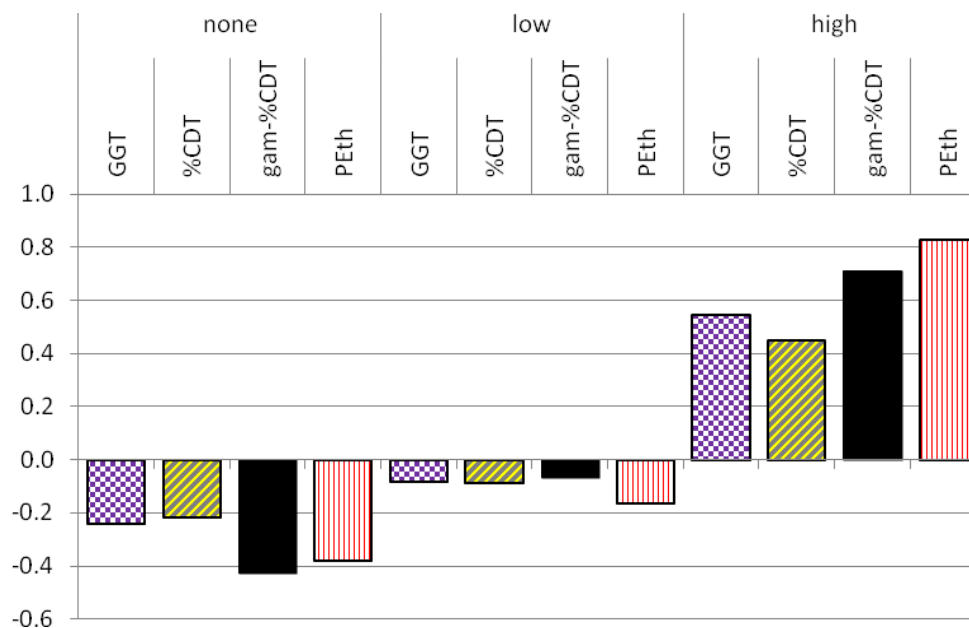


FIGURE 2 Program entry alcohol biomarkers (GGT, %CDT, γ %CDT, PEth) expressed as mean Z scores for three DUI offender risk groups defined on the basis of the subsequent rates of failed interlock BAC tests (no failed BAC tests, low rates of failed tests, high rates of failed tests) during the 8 months after blood sampling.

In addition to the blood markers shown in Figure 2, a subset of drivers ($n = 137$) provided hair samples for the measurement of EtG in hair (long-term alcohol use indicator), and 121 drivers also provided urine for measurement of EtG (short-term alcohol use indicator). The program entry levels of these markers proved sufficient to significantly distinguish the BAC test fail rates during an average 8 months of subsequent interlock use (~2,800 BAC tests/driver). That is, the entry-level markers presaged the behavior that would be logged on the interlock during later months, just as in other studies in which the months of interlock BAC test fail rates predict the likelihood of recidivism. Past behavior is a good predictor of future behavior.

No study has yet demonstrated a direct relationship between entry-level alcohol biomarkers, higher interlock BAC fail rates, and future recidivism. It is a problem of scale. Because re-arrest for DUI offenses is much rarer than drinking and driving, the use of recidivism as an outcome criterion requires several thousand cases to detect an intervention effect. This is no problem with interlock studies because thousands of offenders are using interlocks. As documented earlier, we already know that interlock BAC test fail rates are a good predictor of recidivism.

When the predicted outcome criterion is defined by interlock fail rates (as in Marques et al., 2010b), a relationship between biomarker levels and a quantitative drinking-driver risk metric is readily available, as the interlock fail rate data provide a much more sensitive indicator of drinking than does recidivism. The strongly significant differences in Figure 2 represent 287 offenders; there were just 58 offenders in the high-risk group, but with $P < .00001$ in ANOVA and F ratios ranging from 9 to 35, it is likely that even a study with 150 subjects would have been sufficient to detect a predictive relationship between fail rates and the above markers. This

is not an artifact of skewed distributions as nonparametric rank statistics such as the Kruskal–Wallis test also confirmed a strongly significant group effect. If a jurisdiction were to implement a biomarker trial that was linked to the interlock program, data from thousands of offenders would be possible. Alberta, Canada, which has a provincewide interlock program, is investigating the use of biomarkers for relicensing decisions, but nothing is yet in place.

In 2010, the United States had more than 212,000 interlocks installed (Roth, 2010); Canada has an interlock program in every province, as well as in two of the three northern territories. Nations of the European Union have thousands of alcohol violators who are required to provide blood, hair, or urine samples for biomarker measurements as part of driver fitness evaluations, but in Europe there are still very few offender interlock programs. Somewhere soon it may be possible to study all of these factors, along with driver record variables, in a predictive model. But that time has not yet arrived.

To the extent that biomarkers someday become part of the driver-licensing restitution process in United States, cutoff levels indicative of clinical alcoholism will be too high to serve the purpose of setting risk likelihood assessments of drivers already arrested for driving while impaired. The average GGT and %CDT levels of the drivers in the Marques et al. (2010b) interlock biomarker study had average values near or above the clinical cutoffs. The mean–median entry-level GGT for all 287 drivers in the interlock study was GGT = 48/28 (clinical cutoff for GGT is 50 to 70 IU); the mean–median entry-level %CDT for 283 drivers was %CDT = 2.74/2.49 (clinical cutoff for %CDT is 2.6). The 20% high-risk subset of interlock drivers had many who were over the line; the subgroup mean–median GGT levels were 92/40 and %CDT levels were 3.28/2.91 (Marques, 2011).

None of the alcohol biomarkers are perfect, so for the purposes of aiding driver fitness decisions, it would be ideal if a panel of three or four biomarkers were evaluated to address questions of near-term use, long-term use, and the likelihood of alcohol dependence. Any marker data would have to be used in conjunction with clinical decision making, but these objective indicators, along with other supports such as performance on alcohol interlock tests over many months, would serve to strengthen the evidence base for judgments by the licensing authorities or the courts.

MONITORING METHOD 3: REMOTE TRANSDERMAL ALCOHOL DETECTION

The data log from interlock devices can provide evidence about drinking whenever data are downloaded (typically at about 1- or 2-month intervals); alcohol biomarkers can provide evidence about drinking after samples are taken and sent for analysis (depending on the lab and the type of test, there could be some delay in reporting). Neither of those methods is suited to the needs of monitoring authorities when offenders must be watched more closely. Remote transdermal alcohol-detection devices are designed for daily monitoring. Alcohol-sensing data from transdermal devices can be reviewed by the monitoring authorities after logging onto a secure server accessible through the Internet; new data are uploaded daily.

Approximately 5% of ethanol consumed leaves the body as a gas through the lungs (the basis for breath-alcohol testing to estimate blood levels of alcohol). About 1% of ethanol is lost through the skin (Swift, 2003), and this 1% is the target for transdermal testing. Two electrochemical technologies are used to detect alcohol gas at the skin surface. One method is through use of a conventional fuel cell device that processes the sample and outputs a voltage

related to the ethanol content. This is the method at the heart of all modern ignition interlocks and preliminary breath testers used by police at roadside. The other method is based on a platinum electrode that continuously oxidizes the ethanol.

Near-continuous oxidation current readings that reflect transdermal alcohol levels are periodically averaged and stored (e.g., every 5 min).

These two technologies are available in competing devices: the fuel-cell-based Alcohol Monitoring Systems' (AMS) SCRAM and the BI TAD device based on the Giner platinum electrode; both devices are designed to help monitor the drinking of alcohol offenders. (SCRAM refers to "secure continuous remote alcohol monitoring" and TAD refers to "transdermal alcohol detector.") Both device types lock onto the ankle and cannot be removed without alerting the monitoring authority that tampering or unauthorized removal has occurred. Both types store data from alcohol sensors and other sensors, and the logs of both can be retrieved at least daily. The tampering sensors are similar on both devices. They have the ability to detect gross tampering (e.g., cutting the strap that holds the device on the ankle) and to detect interference or blocking materials (that seek to close off the sensor inlet). Detection is accomplished through use of skin (or near skin) temperature sensors and other sensors that mark proximity to or the reflective qualities of the skin (**Figure 3**).

SCRAM products are the market leader having been available since 2003. In the 8 years up through mid-2011, their market penetration has regularly increased, and according to the SCRAM website, they are being used in all 50 states and have now monitored 184,000 clients. In a message dated July 21, 2011, Don White of AMS noted that "we now monitor about 13,000 [clients]/day." He also noted that, with their growth, there is now quite a lot of consolidation in the market with larger companies buying up smaller service providers who lease or purchase equipment from AMS.

The TAD device is available from BI Incorporated. BI was founded in 1978 and has been in the offender-monitoring business for 30 years. According to BI's website, it provides equipment to 900 corrections agencies in the United States and its territories, as well as Australia and Canada. BI has 12 compliance technologies. Its transdermal product, TAD, was introduced in 2010 and complements BI's older Sobrietor alcohol-compliance-monitoring product that



FIGURE 3 (a) SCRAMx and (b) TAD (images from online vendor websites).

required BAC tests a few times per day. The TAD uses a transdermal sensor that was developed for initial trials as a wrist-worn prototype device called WrisTAS. That initial device, envisioned as an alcohol treatment progress monitoring tool, was designed by Giner, Inc., beginning in the early 1990s with developmental support by the NIH–NIAAA. As BI’s TAD is a new entrant into the transdermal alcohol-monitoring market, its current penetration is still small compared to AMS’ SCRAM. Both companies are based in Colorado.

Both types of transdermal devices accumulate data and can remotely transmit alcohol and other sensor information via modem to a central server over land-based telephone lines. The newer TAD device, working with its home base, also includes a system for communicating via mobile telephone technology; SCRAMx plans to have that capability soon. Operationally, after accumulating alcohol and other sensing information, the devices transfer the data to a modem, which in turn transfers the data to the vendors’ central server–computers for Internet-accessible viewing by the monitoring authority. The frequency with which this occurs is configurable but generally is once a day. The TAD device is programmed to communicate data immediately if alcohol is detected, provided the offender is in range of the modem. The SCRAM device is usually configured to communicate during the sleep hours (i.e., modem in bedroom). Both devices issue an alcohol alert when the amount of alcohol detected exceeds the estimated skin alcohol gas equivalent of $BAC > .02$ g/dL.

Monitoring authorities can track client data and take action promptly if warranted. By providing prompt daily tracking of alcohol use, they fill a niche in the technology available for monitoring high-risk offenders. Neither device outputs BAC because neither measures the alcohol in the breath or the blood, but both are calibrated with alcohol gas concentrations from simulators that emulate breath-alcohol content. The voltage (AMS) or current (BI) outputs are calibrated to known ethanol gas solutions. Both devices refer to their estimated BACs as TACs (transdermal alcohol concentrations).

Several research studies have evaluated the effectiveness of both types of technology. However, because technology developments move faster than the research funds available for evaluation, neither current incarnation of the devices have undergone accuracy evaluation studies. Working with the 2005 versions of SCRAM, laboratory studies by both PIRE (Marques and McKnight, 2009) and by the University of Colorado (Sakai et al., 2006) reported that the SCRAM devices work generally well, and as advertised. PIRE uncovered some problems with water accumulation and alcohol dilution after several days of continuous SCRAM wear that, according to AMS, have since been resolved in the more recent fully redesigned SCRAMx models. The data in **Figure 4** summarizes the dilution problem detected with the earlier SCRAM model. The y axis portrays the true positive hit rate at four BAC intervals. Each line represents 135 episodes of drinking by 30 subjects. Devices worn for 3.3 or fewer days (short duration) had a better true positive hit rate than those worn for more than 3.3 days (Marques and McKnight, 2009). This difference was a consequence of the water accumulation and alcohol dilution.

The early version of the Giner sensor in the WrisTAS was reported to be quite accurate in studies by Swift and colleagues (Swift et al., 1992; Swift, 2000; Swift, 2003). In a later version of WrisTAS or with devices that were not preselected by Giner, Marques and McKnight (2007) found the sensor to function well; however, the WristAS device in which it was incorporated had significant data storage and communication problems that significantly interfered with accuracy determinations. Other than the sensor, the currently marketed TAD device from BI bears little physical resemblance to the WrisTAS.

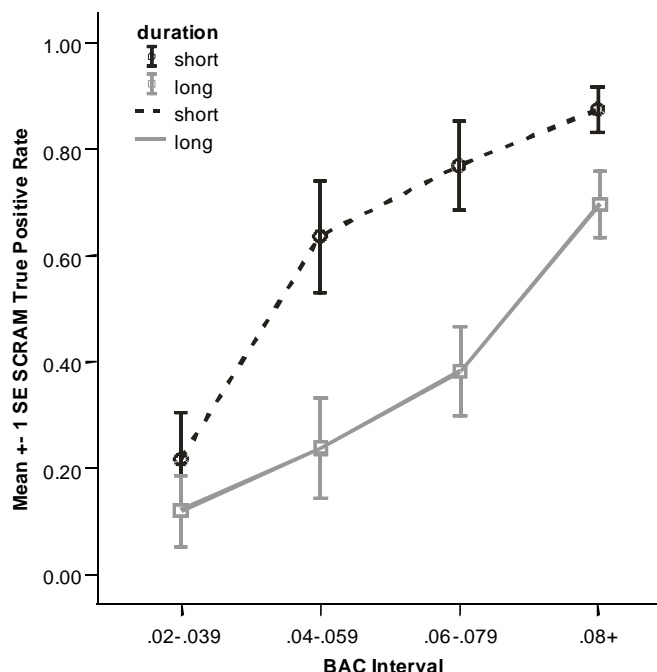


FIGURE 4 First-generation SCRAM devices true positive hit rates for four BAC ranges based on days of wear: short duration (≤ 3.3 days, dashed line) and longer duration (≥ 3.3 days, solid line).

There has been no report of an independent study of the accuracy of TAD or, as noted herein, the newest version of SCRAM. Reports from the field suggest both devices are well regarded by the monitoring authorities who administer transdermal programs. Focus groups conducted with end-user offenders who were outfitted with the earlier SCRAM device found some people significantly benefitted by knowing any drinking would be detected and were grateful for the SCRAM program, apparently because they believed it strengthened their resolve to avoid alcohol. Others raised the issue that whether due to inadequate training or ethical lapses of supervisory or probation staff, a cavalier attitude was a concern to transdermal-wearing offenders who were threatened with a return to jail for alcohol violations (Marques and McKnight, 2007). Although such claims by end users do not reflect poorly on the devices per se, it is a potentially weak link in the chain of rehabilitation.

Both the new TAD and the newer version of SCRAM, SCRAMx, have home-confinement capabilities, such that the ankle bracelets can be programmed to alert the authority if the monitored offender leaves home during certain restricted hours. This feature has been used in stand-alone devices for many years; it is a new enhancement that adds to the capability of TAD.

In stand-alone home confinement devices, these features might allow an offender to travel to work or approved appointments, but would prevent him from being away from home (or some other neutral location) after approved hours. At least two court systems that also had active alcohol interlock programs; Santa Fe County, New Mexico, and Hancock County, Indiana, had judges who used home confinement devices as an alternative to the interlock when DUI offenders professed no intention to drive or claimed no access to a vehicle. In both counties, the availability of the more constraining home confinement option appeared to increase enrollment

in interlock programs (Roth, Voas, and Marques, 2009; Voas et al., 2002), suggesting that the threat of the more constraining ankle bracelet helped goad more interlock installations.

Though not everyone agrees, it may be that the daily cost to offenders of the transdermal devices relative to interlocks (about four to five-plus times higher daily cost) argues for the restriction of these devices to offenders who pose a higher degree of public risk. For example, this might include those who are judged to be high-risk interlock offenders (approximately 20%), those who fail to comply with program expectations, or those who for reasons unrelated to driving, are a threat to family or community when drinking. This class of devices may also serve well as a short-term alternative to incarceration and therefore would offer a significant cost savings over jail. There is no single technology right for all applications, and all of these monitoring technologies can play a role in improving public safety.

MONITORING METHOD 4: OTHER TYPES OF ALCOHOL MONITORING

Portable BAC Test Devices with Data Capture and Photo Capture

When a court does not require an ignition interlock, or a DUI offender does not have a vehicle or otherwise cannot drive, there are alcohol-monitoring options that are cost-compatible with an interlock program (\$2 or \$3 per day). These approaches have emerged in the past few years often to solve a problem for judges who are reluctant to order an interlock for a driver claiming no car. As noted in the preceding section, transdermal testing is a legitimate approach to continuous alcohol monitoring, but these programs do cost considerably more per day than an interlock program. Nonetheless, when a judge believes some form of alcohol monitoring is necessary but does not want costs to exceed the interlock, these are an alternative. More than one device is now available to meet this need. The first was from an ignition interlock provider and was marketed as the Smart Start, Inc., IN-HOM device. The newer entrant is also from an interlock company, the LifeSafer Portable and Home Monitoring Unit (HMU). Additional devices may be under development.

LifeSafer's website notes that "the daily cost is less than a beer in a bar." Both devices capture facial images of the person doing the BAC testing to preclude the benefit of the target offender getting a little help from a friend. Smart Start has noted that its device is in use by judges in Texas and Michigan, and courts in a few others states have shown interest. **Figure 5a** shows the Smart Start IN-HOM; **Figure 5b** shows a photographic image of a test taker; and **Figure 5c** shows the carrying case of the Lifesafer HMU. The BAC testing is required according to a schedule determined by the monitoring authority. The devices accumulate a breath-test record that is stored in the device and can be periodically downloaded and provided to the authority by the service company. So in contrast to transdermal alcohol testing with the daily uploads, these devices store 30 to 60 days of data, capture photos and BACs, and require active participation by the offender rather than the passive detection provided by transdermal testing.

South Dakota BAC Testing

A decidedly low-tech but straightforward approach to BAC monitoring was developed in South Dakota. In this program, offenders are required to appear at the local police station twice per day



FIGURE 5 (a) Smart Start IN-HOM, (b) IN-HOM photo capture image, and (c) Lifesafer Portable and Home Monitoring Unit.

for BAC measurement and to pay \$1 for each test. The purpose is to ensure the authorities that the offender's BAC is zero and therefore in compliance with the program expectations. Failure to comply triggers an immediate night in jail.

The police are satisfied with this approach, it is straightforward and it builds their coffers. The nominal \$2/day cost to the offender does not reflect the fuel and time burden of making these frequent journeys to the station. But on the other hand, a daily reminder that includes some inconvenience might have a deterrence benefit. Substantial success has been claimed for this program by state executive authorities, but this success has not yet been adequately documented for the scientific literature. One submission to a peer-reviewed journal did not meet minimal criteria for scientific evidence. Apparently, the RAND Corporation will soon serve as an external evaluator of this program in a prospective evaluation.

Logically, there is something to recommend an approach that brings a twice per day reminder and requires regular behavioral commitments by the offenders. As the technology discussions in the preceding sections have shown, there are easier ways to do this, but it may be that easy for the offender is not necessarily better for safety. At this time, however, the burden is still on the program to demonstrate that it can be found effective when using recognized methods of evaluation.

Sobrietor

BAC monitoring in fixed locations, such as the home with the BI Sobrietor, requires an offender to provide a breath sample, uses voice recognition or video to positively identify the person as the offender, and then transmits the data over a telephone line. These devices use standard BAC test methods identical to those that have been used in interlock devices. Systems such as these have been used for several years, often as part of house arrest programs (e.g., both to confine the offender to a known location and to require periodic BAC tests). We know of no quantitative information available on the extent to which they are subject to circumvention.

MONITORING METHOD 5: NONALCOHOL MONITORING FOR DUI CONTROL

There are at least two general categories in this section: devices that are attached to the offender via an ankle bracelet to detect his physical location, and devices that are attached to the offender and can detect movement consistent with operation of a vehicle.

House Arrest or Electronic Monitoring

Before the development of a new generation of transdermal alcohol-monitoring devices that could also restrict an offender's movements, there were (and still are) stand-alone products that offer that same capability. This class of devices can serve as an electronic fence that permits movements of the court-controlled offender within a corridor (e.g., home to work), or within certain hours during which these fences can be less restrictive. The devices issue alerts to a probation officer or other monitoring authority if movement outside the restricted area is detected or if a monitoring bracelet is removed. The application of these methods is much broader than the control of DUI offenders, but these home confinement (or house arrest) devices have been used for years before there were transdermal sensors. There is significant literature on this topic known to experts in the criminal justice field.

Motion Detection

An entirely different nonalcohol approach to the control of DUI offenders or others who should not be operating a vehicle has been developed and patented by L3 Communications, a security and engineering company. The technology has now been acquired by Smart Start, Inc., the Texas interlock manufacturer. Smart Start is in the process of redeveloping the technology but, at present, no commercial release date has been announced. When it becomes available it may occupy a unique niche in the use of technology for offender monitoring.

This novel approach features motion detection technology that resides in an ankle-mounted sensor worn by an offender, one who has been ordered to not operate a vehicle. The ankle device detects acceleration and deceleration (positive and negative g forces) and movement of the foot. Inferences about whether a targeted offender (e.g., suspended, revoked, or restricted) is a driver or a passenger can reportedly be discriminated by examining the correlation between foot movements and g forces. These relationships are portrayed in the **Figure 6** graphic showing the g forces (top panel) and a driver and passenger foot movements in the middle and lower panels. All events keyed to the same time on the x axis. A prototype of the technology was demonstrated at various safety meetings in 2010–2011.

At this stage there have been no independent evaluations of this product and little is available about it at this time. In early materials, it was noted that the device can be linked to other technologies via Bluetooth (for uploading data in real time) to Global Positioning Satellite receivers (for position location information) and can work in conjunction with alcohol-detection devices when warranted.

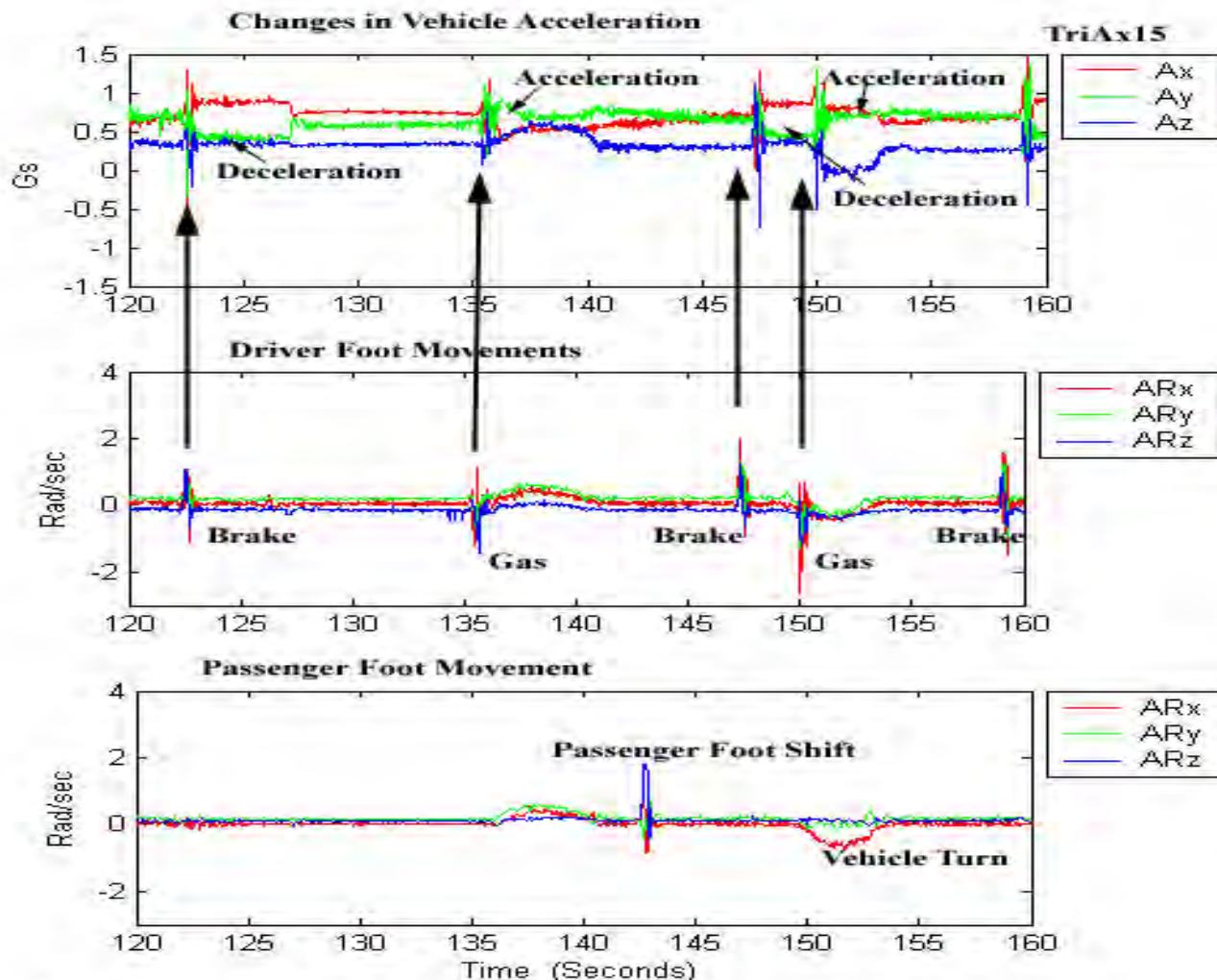


FIGURE 6 Output from prototype LSES technology to detect unauthorized driving.

MONITORING METHOD 6: PASSIVE ALCOHOL MONITORING IN FUTURE VEHICLES

Since 2008, the NHTSA and the Automotive Coalition for Traffic Safety (ACTS) representing the 16 largest domestic and international auto manufacturers have entered into a cooperative agreement to screen and develop technologies for the passive detection of alcohol in passenger vehicles. ACTS, with advisory input from a Blue Ribbon Panel, has worked to evaluate candidate technologies and to assess the prospects for consumer acceptance. This effort is also known as the Driver Alcohol Detection System for Safety (DADSS). Its progress is periodically updated on the website (dadss.org) and the technical information described below is available on that site.

The incentives for this program are easy to understand since our current laws or practices preclude use of technologies that could provide reliable detection of alcohol impairment in

vehicles while they are underway and moving through the traffic stream (e.g., random breath testing, sobriety checkpoints with passive sensors). As noted earlier, less than half of 1% of impaired-driving episodes is detected by the enforcement approaches that are now widely used. If the alcohol-sensing technology were embedded in future vehicles, it could overcome much of the problem resulting from poor detection of drinking drivers in situ and conceivably trump the alcohol industry's penchant for attacking efforts to reduce the alcohol road toll as a form of neo-prohibitionism. To make the program acceptable for the consumer market, it is presumed that any designed-in alcohol-detection technology would have to be passive. Passive detection, of course, is in contrast to the periodic active deep lung breath samples required of DUI offenders who use an ignition interlock device or are required by police at roadside checkpoints. Because the average BAC of an arrested DUI is .16 g/dL and because BACs between .08 and .16 g/dL are currently the most difficult to detect, this technology could bring a significant safety benefit by preventing drivers at .08 g/dL or higher from operating a vehicle.

As of January 2011, two candidate technologies had performed sufficiently well that they are being considered for further development (distance spectrometry, or breath-based and tissue spectrometry, or touch based). Their criteria required a demonstration of acceptable precision and accuracy as well as the ability to make measurements quickly enough to avoid inconveniencing the driver (Ferguson et al., 2011). The technology will have to be reliable, durable, and add acceptably affordable costs to new vehicles. These are very significant challenges for a new technology considering the highly variable environments—hot, cold, moist, dry, breezy—in which automobiles and their drivers operate. Presumably the selected technology will have to be able to do so reliably for the average 11 year life of a vehicle that is started an average of five times per day. The industry's estimates may differ, but five starts per day is a conservative estimate that comes from interlock log file data of 15,000 drivers.

The distance spectrometry approach developed with Autoliv (Sweden) is based on measurement of concentration differences in expired alcohol and CO₂ gases relative to those gases found through multipoint sampling in the environment. The tissue spectrometry approach from TruTouch in Albuquerque, New Mexico, is based on infrared detection of capillary alcohol concentration detected following touch. Phase I prototypes had accuracy and precision results that are near or better than evidential devices but not always as good as DADSS' more stringent criteria.

The technical challenge may become more difficult when the devices are subjected to real world use by average drivers or when the next phases of development unfold. One of the barriers that will have to also be overcome is public acceptance. This is one of the core aspects of the program from the beginning, albeit one that is only now beginning in earnest. A survey by the IIHS (2009) determined that 64% of the public will support technology of this kind if it is a reliable and effective way to prevent driving with a BAC higher than .08 g/dL.

DISCUSSION OF TECHNOLOGIES

Review of the Technologies

Developments in monitoring technology hold the promise of bringing alcohol consumption data to the task of determining driver fitness following a DUI conviction. None of these methods is

the best choice for all situations, and the selection of monitoring and control devices should depend on the questions or problems that need attention.

Ignition interlock programs are relatively low cost (~\$2 to \$3 per day), and though often embarrassing for the person who has to use them, are a minimal inconvenience compared to other sanctions that further restrict freedom to operate in society. When used according to program instructions, interlocks substantially protect the driving public from alcohol-related risks by the driver of an instrumented vehicle. Examination of the breath-test records brings the added virtue of providing some information about a driver's future risk of repeat DUI after the program ends and the device has been removed. However, most research into the interlock data and the likelihood of future recidivism has only been shown in an aggregate relationship. The value of interlock BAC data to prospectively predict the risk of a specific driver has still not been reported, so it remains unclear at this time what the true positive and false positive rates would be at the person level.

Alcohol biomarkers, such as PETH, EtG, GGT, %CDT, and γ %CDT can inform decision makers about the extent to which a specific individual has been drinking recently, or with hair testing even over the past several months. The cost of conducting laboratory tests of three or four different markers could be \$50 to \$100 or more if hair testing for EtG is included. Actual prices would depend on volume and the tests selected. There could be some delay in receiving results; however, if the question concerns the extent of the driver's alcohol use, or if measures are done at a critical time such as relicensing or graduation from alcohol treatment services, the markers can provide strong evidence about which drivers' alcohol-use levels should be of concern.

In most cases, transdermal alcohol-testing bracelets provide daily information as to whether a monitored offender is drinking alcohol. These devices generally have a lease fee equivalent to approximately \$12 to \$15 per day that, in most circumstances, is the offender's responsibility to pay. These costs, though high relative to an interlock, are low compared to the cost of jail, a sanction that is often the alternative to transdermal monitoring. The newest versions of the devices have not been independently evaluated for accuracy and precision after long-term wear. However, there is no evidence to suggest that these devices have not overcome the problems reported during research on earlier versions. Nonetheless, it would be nice to see a study of long-term use with the new models since their most common use is for several months.

When regular monitoring of alcohol is desired but the transdermal method is not appropriate, regular breath BAC testing is a lower-cost alternative that does not appreciably limit the mobility of offenders. At least two types of methods are available. These include portable photo-capture enabled BAC test devices that are cost-compatible with an interlock but do not require a vehicle, and regular reporting to a central station where daily breath BAC tests can be performed. The portable instrument delivers data only when actively downloaded—whether weekly, monthly, or bimonthly. The in-person method of reporting to a police station for BAC testing, as is done in South Dakota, provides results immediately.

Methods to restrict or detect unauthorized travel can also contain the behavior of the DUI offender. These include the widely used electronic house arrest option, or the still new motion detection and g-force sensors of LSES. The latter is not yet available nor is a potential cost known. A device such as this might be exactly right for the persistent driving-while-suspended (DWS) offender because, if the technology performs as advertised, it would bring the capability to issue instant alerts with location information when a DWS driver was in the driver's seat operating a vehicle.

Finally, over the horizon is the possibility of native alcohol detection built into new vehicles. The prototype results have been impressive, but it is still not known if these technologies can be packaged into a durable, affordable, built-in feature for future vehicles. With a 2/3 conditional endorsement of this approach by the public, even before any active promotion or explanation (or alcohol industry opposition), it is an excellent start. As rollout nears, the program developers will need to be attentive to the problem of circumvention by motivated users. For example, in New Mexico, Roth studied the re-arrest of interlock equipped offenders. Most researchers had assumed that re-arrest of interlock stipulated offenders nearly always occurred in a noninterlock car. But Roth compared vehicle license tags noted by the arresting officer to license tags of the interlock equipped car. He found that of the small number of interlock stipulated offenders who were re-arrested during the interlock program, 25% to 30% of them were driving in the interlock equipped vehicle (Marques et al., 2010a). So the DADSS group should not underestimate the creativity of a motivated driver. The new car technology may never be foolproof, but none of the other technologies are either.

Context for the Technologies

From the foregoing, it appears there are two main paths that could reduce the alcohol road toll: to use more data-driven intensive monitoring and treatment services for the offenders who are captured and convicted, or to cast a wider net to facilitate detection of a higher proportion of alcohol-impaired drivers. Several of the technologies summarized could aid in achievement of either of those target objectives. The best results would probably come from a combination of both.

If the technology were only directed toward those who are arrested and convicted, it is likely that a substantial impact could still be made on reducing the likelihood of recidivism. This might include a more comprehensive linkage of interlock programs, treatment programs, biomarker monitoring, or transdermal monitoring before reissuance of an unrestricted license. The integration of these methods might improve the weak alcohol treatment outcomes by bringing real performance–consumption data to the treatment milieu and, in so doing, eliminate much of the guesswork about driver fitness.

More attentive monitoring and expectations for real behavior change during treatment might also carry a strong general deterrence effect.

Although offenders are a good target for more intensive intervention, we should not fail to note that only a few percent of alcohol crashes involve drivers with prior DUI offenses. Offenders are too small a population to target for a real impact on the road toll because it is difficult to detect and arrest those who drink and drive. As mentioned earlier in this document, data from Miller et al. show that well over 99.5% of all impaired-driving episodes go undetected. Accordingly, only 8% of drivers in fatal alcohol-impaired crashes ($BAC \geq .08$ g/dL) had a prior DUI (NCSA, 2010). This means that 92% of the alcohol fatalities would not have made it into the intensive monitoring programs if solely restricted to DUI offenders.

It might be best if it were possible to improve alcohol detection in the traffic stream. This could be done by use of more sobriety checkpoints (which the law allows), or by introducing random roadside BAC testing, (which U.S. law does not currently permit). Alternatively, the occasion of regular relicensing could present an opportunity to evaluate the alcohol-use status of renewal candidates. A brief intervention by a licensing authority might have a beneficial effect on the alcohol use of a licensee, much as brief interventions by physicians have been shown to improve health behaviors of patients.

Without better methods for lowering the use of alcohol among the driving public, we may be destined to wait the 20+ years until all vehicles are equipped with the new alcohol sensing technology. That may be the answer, assuming it works, assuming it is affordable, assuming it can be required, and assuming it cannot be circumvented by motivated, committed drinking drivers. A more expedient approach in the meantime would be to allow for random roadside breath testing, greater use of sobriety checkpoints with passive alcohol detection devices, and perhaps lowering the BAC limit to .05 g/dL. In the meantime, alcohol beverage interests will continue to promote the joys of drinking to youth and other vulnerable segments of society.

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Reducing Recidivism and Promoting Sustained Change

A Process of Change Perspective

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Over the past 20 years there have been important advances in technologies that enhanced our ability to monitor individuals and provide the information to better control substance abuse and drinking behaviors. We have biochemical assays and markers that indicate when an individual has been using a particular substance within certain time parameters. We have sensors that can be worn to detect excessive alcohol consumption (SCRAM technology). We have the ignition lock technology that can control access to motor vehicle use when a driver has been drinking. At the same time we now also have increased knowledge about contingency management and how to use reinforcers, like money, housing, and take-home doses of methadone, to encourage abstinence from a particular substance (Petry et al., 2005b). Studies show that we can get more clean urines from heroin and cocaine addicts by offering money or lottery-like rewards (Olmstead and Petry, 2009). It is clear that, if we have the ability to monitor, control, or immediately reinforce drug and alcohol abstinence, we can interfere with the individual's ability to engage in these behaviors and associated risk-taking behaviors like driving under the influence. In the short term these technological and scientific advancements have helped to achieve to some extent the goals of protection of society from risk and to support control mechanisms in risk taking individuals who have come into the legal system and received sanctions.

The real challenge to any type of imposed change that is administered by others is that once the sanctions are lifted or the time period of active control or reinforcement is expired, the individual has to sustain any changes in behavior without the assistance of sanctions, technology, or extrinsically delivered reinforcers. Relapse or a return to problematic drinking or substance use often occurs once these external controls are lifted. There seem to be two important aspects underlying the short-term nature of externally controlled or imposed change. The first is that if a behavior is largely or exclusively under external control and what are called extrinsic motivators or incentives, the intrinsic motivations or internal control mechanisms that can sustain the change are often underdeveloped. There is a time limit to sanctions and even jail terms that limit the utilization and effectiveness of external control. There seems to be an important difference between stopping a behavior and changing a behavior (Stotts et al., 1996; DiClemente, 2003). The second critical element for understanding relapse is that long-term sustained change is elusive and can occur even after multiple courses of voluntary treatment, especially if we are talking about total abstinence from alcohol and drugs (DiClemente, Holmgren, and Rounsaville, 2010). Both the time-limited nature of external control and the difficulty sustaining a behavior change over time require a more in-depth and extensive understanding of the process of intentional behavior change in order to maximize the impact of sanctions and new technological advances.

THE PROCESS OF CHANGE

There is a significant difference between imposed change and chosen change. Imposed changes require control of the person's environment and engender the conviction that there is little or no choice and that the change is being made for others (Stotts et al., 1996). Sanctions typically depend on these mechanisms of imposed change. There are several potential responses to imposed change: resentment, resistance or rebellion, anger and aggression, depression, and, possibly the most healthy responses, acceptance and resilience or making the best of a bad situation. Imposed changes like the death of a loved one, a disabling injury, a divorce, or a criminal adjudication evoke a variety of responses and how these reactions are managed is critical to how the imposed change is integrated into the life of the individual.

Chosen change, on the other hand, involves a process of intentional change that is complex. In contrast to imposed change, intentional or voluntary change is complicated and multidimensional. However, it can be connected with imposed change and can be part of the acceptance–resilience solution to imposed change. It takes a number of elements to create successful sustained change whether one talks about being “ready, willing, and able” or having “motivation, commitment, skills, and support” (CSAT, 1999; DiClemente, 2003). The transtheoretical model (TTM) and its stages of change offer a way to identify, organize, and sequence important dimensions of the intentional process of change (Prochaska, DiClemente, and Norcross, 1992). This model will be used to discuss how to create opportunities for chosen change in programs that focus on sanctions and imposed change.

STAGES AND TASKS OF CHANGE

The intentional change process involves several critical tasks that need to be accomplished in order to initiate, modify, or stop a pattern of behavior and to consolidate behavior change into a stable pattern. Stages represent a set of tasks that build the foundation for successful change (Table 1). Individuals change voluntarily when they become *interested and concerned* about the need to change, conduct a *risk reward decisional analysis* that indicates that change is in their best interest, make a *commitment* to an *effective and acceptable plan of action*, take the *actions* needed to make the change, and finally *integrate* the change into their lifestyle (DiClemente, 2003). The end product is a new sustained pattern of behavior supported by the adequate accomplishment of each preceding task. Stages bring together the cognitive and motivational, as well as behavioral learning elements of change to create a larger, more complex, and more credible picture of the process of change. Stages also shift the conversation about change from an exclusive discussion of action outcomes to one that increases the focus on motivation, decision making, commitment and planning.

Stages of change create a dynamic view of the change process (DiClemente, Schlundt, and Gemmell, 2004). Individuals can move forward, backward, and recycle through the stages. Some people become stuck in certain stages like precontemplation and contemplation for long periods of time. Others consider change, then reject it, and return to precontemplation. Still others make a decision and a plan, but fail to implement it. The path to successful behavior change seems to involve accomplishing stage tasks well enough to be effective in creating a new pattern of behavior and each person has a personal change history.

TABLE 1 Stages and Tasks of Intentional Behavior Change

Stage	Task
Precontemplation	Arousal of concern about current problematic behaviors. Creating emerging interest in changing a problem behavior or developing a new behavior.
Contemplation	Analyze the risks and rewards of the old and the potential new behavior. Make a decision to change.
Preparation	Create and commit to a plan to enable behavior change.
Action	Implement, stick with, revise, and reform change plan.
Maintenance	Integrate new behavior into lifestyle.

Successful behavior usually includes:

- Significant concern,
- Solid decision making,
- Sufficient planning,
- Significant commitment,
- Change–plan implementation intention,
- Behavioral enactment, and
- Generalization of the behavior.

Relapse is an event that signals the individual and the intervener that one or more stage tasks have not been completed adequately. Rather than indicating failure and implying that an individual cannot change, relapse is a marker of inadequate learning and problematic completion of stage tasks. Relapse can be part of the process of change and represents learning by successive approximations, allowing individual to get closer to a change goal by learning how to get all the parts of the process right (DiClemente, 2003; DiClemente, Holmgren, and Rounsaville, 2010). This dynamic framework makes it imperative that behavior change specialists be aware of both the critical tasks and stages necessary for change, where clients are in this process, and what tasks they have accomplished in this process thus far.

PROCESSES OF CHANGE AND THEIR INTERACTION WITH THE STAGES

The original insight underlying the TTM was that individuals at different points in the stages of change used different processes of change (Prochaska, DiClemente, and Norcross, 1992). Processes represent the active ingredients or change engines that enable individuals to accomplish the tasks of the stages, move through the process, and achieve successful, sustained behavior change. Client experiences, thoughts, and actions foster and energize movement through stages and accomplishment of tasks. In order for an addicted individual to become concerned enough about the status quo (precontemplation task) to consider a new way of behaving, and then to engage in a risk reward analysis (contemplation task), he has to increase awareness (consciousness raising), reevaluate both the status quo and the new behavior (self and environmental reevaluation), and hopefully get upset about the costs of the current behavior

(emotional arousal). These processes are critical for accomplishing both the precontemplation and contemplation tasks. Additionally, choosing a course of action to change the problem behavior and committing to that choice (self-liberation) are essential for accomplishing the tasks of the preparation stage. Similarly, learning how to create or deconstruct cues to action (stimulus control), modify conditioned responses to cues (counter conditioning), and create rewards for new behavior (reinforcement management) are critical to the action and maintenance stages. As the client moves through each of the stages, but particularly in the preparation stage, it is helpful if he has trusting and open discussions about the problem behavior with a supportive individual (helping relationships). Without successful engagement in these processes of change, the individual is unlikely to successfully accomplish the tasks of the stages, modify the target problem behavior, and sustain the new pattern of behavior. However, the client does not use processes in a vacuum, uninfluenced by contextual factors or the interventions of others.

Specific types of process assistance include

- Influence and advice,
- Inspiration and motivation,
- Ambivalence reduction,
- Decision-making support,
- Commitment enhancement,
- Planning and prioritizing,
- Skills building,
- Implementation support, and
- Maintenance support.

The goal of an intervention should be to engage and influence appropriate processes that can help clients accomplish tasks. Interventions should be constructed, materials created, and techniques taught to assist our clients in accomplishing critical stage tasks needed for success, or to learn from recycling how to be more successful in moving through the stages (Carbonari and DiClemente, 2000). Processes of change refocus us on client coping activities and again offer a dynamic view of change. However, individuals differ significantly based on education, ethnicity, social connections and networks, economic standing, age, and cultural values. Knowing how to activate appropriate processes for individuals with diverse cultural backgrounds, ethnic traditions, and values is essential for creating effective interventions. Moreover, individuals differ in self-regulation skills and their “self-control muscle.” Impaired or exhausted self-control requires more external structure and support to achieve adequate self-regulation to engage in and successfully complete stage tasks.

INTEGRATING SANCTIONS WITH THE PROCESS OF CHANGE

The challenge for all criminal justice settings and interventions is how to make an essentially punishment and sanction-oriented system into an opportunity or a teachable moment for intentional change that can promote sustained behavior change even after the punishment, monitoring, and sanctions have ended. There are a number of initiatives that try to promote intentional change and utilize sanctions and criminal justice settings as opportunities to turn imposed change into chosen change (DiClemente and Velasquez, 2002). Examples include drug

and alcohol courts, substance abuse treatment programs housed in prisons, training probation and parole officers in this process of change perspective, and brief interventions administered in high-risk medical settings where legal and medical concerns come together (Miller and Rollnick, 2002; Soderstrom et al., 2006). This section will highlight several ways to foster integration of the intentional change process into the use of sanctions or punishments and some barriers to accomplishing this goal. We will start with the barriers.

Coercion and control are critical to imposing punishment and creating successful sanctions. If an individual believes that he or she can circumvent the sanction, control of the behavior will be ineffective. Witness all the creative ways individuals have to try and foil drug testing, defeat ignition locks, enable banned activities in prison, and even fool newer technologies like ankle monitoring. Control and punishment engenders efforts to circumvent or to emit the minimal responding necessary to avoid unwanted consequences. Creating the conditions whereby the individual perceives control mechanisms as aids to self-change rather than obstacles to overcome is a significant challenge.

Coercion also engenders resistance. Resistance is not a property of addiction. It is a part of being made to change a behavior that is valued for some reason by the individual. In this type of atmosphere it is difficult to get the honest responding and genuine interactions needed to engage and promote the intentional change process. Motivational interviewing has been developed as a style of interacting and set of communication strategies that attempt to create the atmosphere and type of conversation that is client driven that can overcome resistance and promote engagement in the change process (DiClemente, Garay, and Gemmell, 2011; Miller and Rollnick, 2002). It teaches a collaborative, empathic, evocative yet directive style of communication that has been effective in promoting change (Burke, Arkowitz, and Menchola, 2003; Miller and Rollnick, 2002).

Creating positive, intrinsic motivation in settings and programs that can elicit negative reactions and extrinsic motivation demands creative and innovative thinking and approaches (DiClemente, 2003; DiClemente and Velasquez, 2002). Sanctions and interactions with the legal system create a teachable moment and provide an opportunity to engage the intentional change process even during an episode of imposed change. The challenge is to create an interaction that will respect that the individual offender has choices and that choices have consequences and, at the same time, create an opportunity for the individual to engage in the processes of consciousness raising, self-re-evaluation, emotional arousal, and environmental re-evaluation that can promote the personal interest and concern and the needed decision-making activities that can stimulate the process of change. Then the challenge becomes one of helping the individuals develop the commitment and effective planning needed to make changes that will endure beyond the sanctions, changes that the individual sees as in his or her best interest, changes that can be facilitated and supported by the sanctions.

How can this transformation be achieved? First, we must be realistic. Engaging the change process is not a miracle cure that will eliminate recidivism. Remember relapse is part of the process of change. The goals of protecting the public from the problematic choices of offenders require effective use of sanctions and controls. However, how we impose and implement these controls is as important as the type of control or sanction we are employing. We need to integrate motivational approaches and strategies into our implementation protocols.

For some of the individuals who are given sanctions, the criminal justice event is already a wake-up call and creates a “teachable moment” when there is greater vulnerability and openness to consider change. Stigma, labeling, and treating individuals as criminals who simply

have to “do the time” or follow the rules can do more to interfere with rather than to facilitate the intentional change process. This is not simply a plea to coddle or go soft on criminals as some critics may claim. It is also not a plea to undermine or avoid consequences or sanctions. Consequences can teach and be effective in promoting change, even intentional change. However, the level of recidivism in the criminal justice system indicates that consequences are not always effective teaching tools. The goal of all criminal justice interventions is long-term protection of the public from the actions of individuals who break the laws as well as rehabilitation or sustained change of behavior on the part of the offender. Sustained change beyond sanctions seems to require a greater focus on the intentional process of change. Using the teachable moment of the infraction related to abuse of alcohol or drugs to create long-term sustained change fits perfectly with this goal.

In order to achieve this goal, the following recommendations are made:

1. Create implementation protocols for sanctions that include consideration of the intentional change process. Consider how each aspect of the sanction protocol can be used to engage processes of change and promote completion of critical change tasks.
2. Educate court personnel to understand the change process and be mindful of it in their interactions with offenders as has been done with drug and alcohol court personnel.
3. Train court personnel and sanctioning boards in motivational enhancement style and strategies, in the science of contingency management, and how to integrate these with the imposition of sanctions and consequences.
4. Develop a system that gives offenders access to help to engage in the intentional process of change and do not simply rely on sanctions and extrinsic motivation to create sustained change.

These recommendations may require a shift in perspective and a more multidisciplinary and integrative approach to managing alcohol and drug infractions in transportation settings. The wonderful advances in technology for behavior monitoring and control offer the opportunity to create a more effective and integrated responses to these infractions that can address the challenge of integrating intentional change and imposed change processes to create sustained behavior changes that are in the best interest of individual as well as society.

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Sanctions and Rewards in DUI–DWI Court Settings

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The purpose of this paper is to present what is known about the use of sanctions and rewards in the driving under the influence–driving while intoxicated (DUI–DWI) court process, as one strategy to address impaired driving. First, the existing research on DUI–DWI courts will be presented. This will be followed by a brief description of how DUI–DWI courts overlap with Vaillant’s (1995) alcohol abstinence research findings. The existing research on the use of sanctions and rewards in DUI–DWI courts will then be presented, followed by factors to consider in sanctions and rewards, and how to capture the sanctions and rewards process in evaluation research.

DUI–DWI COURTS

DUI is a paradoxical crime because it can be among the least serious or most serious risks to public health. [Note: DUI is also referred to as driving while intoxicated or DWI. DUI and DWI will be used interchangeably throughout to refer to drinking and driving.] A drunk driver may get caught for veering off the road, with no serious injury, or may cause a fatal accident. No clear pattern of which drunk drivers contribute most to traffic fatalities has been found. In a national study, adults who reported drinking in the last 12 months but not to intoxication and who had no alcohol diagnosis were found to contribute the most to alcohol-related crashes. This was in contrast to four mutually exclusive groups of heavy drinkers (dependent drinkers, abusive drinkers, dependent and abusive drinkers, and heavy episodic drinkers) (Voas et al., 2006). The number of times that people drink and drive before being arrested has been cited as ranging from 300 to 2,000 (Voas and Fisher, 2001). Some reliable predictors for DUI recidivism have been identified (such as being male and under 30 years old), but are too general to be of practical use (Nochajski and Stasiewicz, 2006), and have not been linked to traffic fatalities. In his analysis of more than 50,000 DUI records in California, Marowitz (1998) found that the odds of DUI recidivism were highest for those with low and high breath alcohol tests. Ethnic similarities and differences have also been identified, with few clear findings emerging across studies (Caetano and McGrath, 2005; Cherpital and Bond, 2003; Ferguson et al., 2002). For example, in their analysis of data from 39,250 adults respondents for the National Household Survey on Drug Abuse, African Americans and Latinos showed lower rates of DUI behaviors, but higher rates of arrest compared to whites (Caetano and McGrath, 2005). Higher arrest rates were also found among a stratified sample of Mexican Americans compared to whites, with previous DUI convictions predicting subsequent DUI arrests for Mexican Americans but not for whites (Cherpital and Bond, 2003). In another study, Mexican Americans reported drinking more and more often compared to whites, but they also reported a higher threshold for how many drinks it would take to be an unsafe driver. Both groups, however, overestimated the number of drinks it took to reach a level of unsafe driving (Ferguson et al., 2002). As concluded by Nochajski and Stasiewicz (2006), DUI offenders are a heterogeneous group, requiring observation of a large number of variables at the legal, social, and psychological levels to explain relapse.

DUIs remain a concern to public health and a burden on public safety. Nationwide, more than 1.4 million drunk drivers are arrested each year (*Crime in the United States*, 2009). On a percentage basis, the vast majority of arrests result in no serious injury. However, alcohol-impaired drivers accounted for almost 11,000 deaths in 2009, or 32% of all traffic fatalities (NCSA, 2010). Motor vehicle accidents accounted for almost 10% of injury-related emergency department visits, totaling 3.9 million (*National Hospital Ambulatory Medical Care Survey*, 2011). Costs of alcohol-related traffic accidents have been estimated at \$51.1 billion or 22% of economic costs for all motor vehicle crashes (Blincoe et al., 2002). DUIs can also become media events, with or without celebrity involvement, often appearing on the front page with some mention of policy included (Myhre et al., 2002; Smith, Twum, and Gielen, 2009).

DUI courts were created to address this dual emphasis on public health and public safety and were patterned after the collaborative drug court model. The goal of DUI courts is to address the underlying causes of impaired driving and to protect public safety by holding offenders accountable (Freeman-Wilson and Huddleston, 1999; Huddleston and Marlowe, 2011). DUI courts also emerged in response to the intervention literature which suggested that a combination of legal and rehabilitative approaches applied together have the greatest potential to reduce DUI relapse (DeYoung, 1997; Nochajski and Stasiewicz, 2006; Voas and Fisher, 2001). Like drug courts, DUI courts have brought together the criminal justice and public health systems to collaboratively address DUI convictions.

Nationwide, there are approximately 172 “designated” DUI courts, meaning only DUI cases are processed, and another 354 “hybrid” drug courts that include DUI cases along with drug cases. Compare this to the more than 2,200 drug courts currently in operation (Huddleston and Marlowe, 2011). Clearly, DUI courts are a much less commonly occurring phenomenon, but are still being tried. Patterned after drug courts, DUI courts are also a type of problem-solving court, which are defined by their focus on addressing the underlying social issue as a means to enhance public safety. In the case of DUI courts, this means that alcohol use is specifically addressed. A cooperative team approach is taken, similar to the collaborative decision-making team in the drug court model, to change defendant behavior related to drinking. The DUI problem-solving approach includes: (a) a team of criminal justice and substance abuse treatment professionals to work together to change the behavior of DUI offenders; (b) early identification and referral to alcohol treatment and other needed services; and (c) monitoring of treatment compliance through testing, close community supervision, and ongoing interaction with the judge (Huddleston, Freeman-Wilson, and Boone, 2004).

In their description of problem-solving courts, Berman and Feinblatt (2005) put less direct emphasis on treatment issues and identified the following five key elements of problem-solving courts:

1. Tailored approach to justice matching need to expertise;
2. Creative partnerships including collaborations;
3. Informed decision making including incorporating psychosocial information;
4. Accountability through judicial monitoring; and
5. Focus on results to determine effectiveness.

However, treatment is clearly emphasized in the National Drug Court Institute’s (NDCI) 10 Guiding Principles for DUI–DWI courts, particularly guiding principles two (perform clinical assessments) and three (develop the treatment plan) (NDCI, 2006). Other guiding principles

emphasize supervision that includes probation, regular and random testing, sanctions, visits to the home and workplace, staffing via a collaborative team of treatment and criminal justice professionals to monitor cases, and regular contact with the judge.

What then constitutes a DUI court? Key elements typically include (Marlowe et al., 2009; NDCI, 2006):

1. Judicial status or review hearings on an ongoing basis;
2. A collaborative team of treatment and criminal justice professionals supervising cases and monitoring progress;
3. Intensive substance abuse treatment and any other necessary ancillary services to address alcohol use;
4. Random or continuous testing to monitor alcohol use;
5. Graduated negative sanctions for program violations and positive rewards to monitor progress.

In addition, the following are also common across DUI courts (Marlowe et al., 2009; NDCI, 2006):

1. Most DUI courts occur at the post-adjudication stage when offenders have already been convicted;
2. Many DUI courts require at least some of the incarceration sentence to be served in jail;
3. Failure to successfully complete or graduate results in a return to custody.

The purpose of this paper is to present what is known about the use of sanctions and rewards in the DUI–DWI court process, as one strategy to address impaired driving. First, the existing research on DUI–DWI courts will be presented. This will be followed by a brief description of how DUI–DWI courts overlap with Vaillant’s (1995) alcohol abstinence research findings. The existing research on the use of sanctions and rewards in DUI–DWI courts will then be presented, followed by factors to consider in sanctions and rewards, and how to capture the sanctions and rewards process in evaluation research.

EFFECTIVENESS OF DUI–DWI COURTS

The evaluation research on DUI–DWI courts is limited, in part due to the relatively small number of DUI–DWI courts available for study and their reasonably new introduction into criminal justice practice (Huddleston and Marlowe, 2011). Care must also be taken in differentiating a fully implemented DUI court that includes the relevant key processes (regularly scheduled judicial status hearings and sanctions and rewards to monitor compliance, collaborative treatment and legal team case decision-making, individualized alcohol treatment, regular alcohol and drug testing) from a standard court processing or a “business-as-usual” approach (Huddleston and Marlowe, 2011; Marlowe et al., 2009).

Probably the most thorough analysis of the existing evaluation research on DUI–DWI courts was a systematic literature review of 14 published and unpublished research and evaluation studies by Marlowe et al. in 2009. The authors used the Methodological Quality Scale

(MQS), adapted from the *Mesa Grande Coding System for Methodological Quality* (Miller and Wilbourne, 2002; Marlowe et al., 2009) to rate the quality of selected studies. This system was developed to rate alcohol treatment evaluations and thus was easily transferable to DUI–DWI court settings. The MQS consists of 13 categories, including areas such as study design, replicability, use of baseline measures, follow-up interval, and dosage. Each category has pre-determined response categories. A total score is rendered by adding up all of the ratings, with lower scores indicating greater methodological quality.

Initial selection of studies was the result of a comprehensive literature review and reaching out to points of contact in every state and territory through the National Drug Court Institute and the National Network of State and Territorial Drug Court Coordinators. From this search, a total of 41 published and unpublished DUI–DWI court evaluations were gathered, including one evaluation from each of 17 states. Among these 41 studies, 27 were eliminated due to insufficient reporting of required elements, such as including client-level outcomes, resulting in 14 remaining studies that were subjected to the MQS by two raters. The overall finding of the systematic review was that favorable outcomes were suggested but there is still not enough scientific evidence to draw any definitive conclusions on DUI–DWI courts (Marlowe et al., 2009).

A total of nine DUI–DWI studies were reviewed for this section. This includes five of the six highest rated studies included in Marlowe et al. (2009), plus an additional three recent evaluation reports and publications (Bouffard and Richardson, 2010; Hiller, Saum, and Taylor, 2009; Petrucci and Ireland, 2008). The sixth study in Marlowe et al. (2009) was an evaluation of three Georgia courts. A newer evaluation has since been published, so the new report was substituted for the previous one. The three recent studies included one peer-reviewed publication (Bouffard and Richardson, 2009) and two evaluation reports (Hiller, Saum, and Taylor, 2009; Petrucci and Ireland, 2008). This selection approach may have missed some existing evaluation reports, but care was taken to include studies that were discussed at professional meetings, cited in the pertinent literature, and an additional search was conducted in relevant databases. Therefore, these nine studies are believed to represent the best known and most pertinent of the currently available studies.

Not unlike much early outcome evaluation work with a limited number of studies and no large scale multisite evaluations or longitudinal studies, some studies have found promising outcome results, while others identified minimal or no differences. **Table 1** presents study results for the nine studies examined in this analysis. Among the promising results were studies in Michigan (Michigan State AOC and NPC Research, 2008), Georgia (Fell, Tippetts, and Langston, 2011), Wisconsin (Hiller, Saum, and Taylor, 2009), Oregon (Lapham et al., 2006), and Orange County, California (Petrucci and Ireland, 2008). One study in Arizona found positive outcomes for graduates only (Jones, 2005). Among those with minimal or no differences were studies in Los Angeles (MacDonald et al., 2007), New Mexico (Breckenridge et al., 2000), and a mid-western state (Bouffard and Richardson, 2010).

Upon closer examination of the implementation elements expected to occur in DUI–DWI courts, shown in Table 1, two out of three of the studies with no statistically significant differences were missing three (out of five) key implementation elements. In the Los Angeles site (MacDonald et al., 2007) four elements were missing for some of the DUI offenders. For 2nd time DUI offenders, there was no substantive treatment component. For all DUI offenders in this court, there was no collaborative team decision making, no testing, and no sanctions and incentives issued by the judge. In a separate publication on the same court, by their own admission, the authors acknowledged minimal implementation differences between the

TABLE 1 DUI Court Elements Present and Not Present and Study Results

Study	DUI Court Elements Present or Described	DUI Court Elements Not Present or Not Described	Study Results (at $p < .05$)
Bouffard and Richardson, 2010: Midwestern state	Treatment Testing	Judicial review Collaborative team Sanctions or rewards	No statistically significant differences
Breckinridge et al., 2000; Winfree and Giever, 2000: New Mexico	Judicial review Treatment Sanctions or rewards	Collaborative team Testing	No statistically significant differences
Fell et al., 2011: Georgia	Judicial review Collaborative team Treatment Testing Sanctions or rewards	None	Statistically significant outcomes favoring DUI court
Hiller, Saum, and Taylor, 2009: Wisconsin	Judicial Review Collaborative Team Testing Sanctions/Rewards	Treatment	No statistically significant differences
Jones, 2005: Arizona	Judicial review Collaborative team Treatment Testing Rewards or sanctions	None	Statistically significant differences favoring DUI court graduates only
Lapham et al., 2006: Oregon	Alcohol treatment Alcohol testing	Judicial review Collaborative team Sanctions or rewards	Statistically significant outcomes favoring DUI court
MacDonald et al., 2007: Los Angeles	Judicial review State required alcohol education program 3-month treatment program	Collaborative team Testing Sanctions or incentives Long-term, individualized treatment	No statistically significant differences
Michigan AOC and NPC Research, 2008: Michigan	Judicial review Collaborative team Treatment Testing Sanctions or rewards	None	Statistically significant outcomes favoring DUI court
Petrucci and Ireland, 2008: Orange County, California	Judicial review Collaborative team Treatment Testing Sanctions or rewards	None	Statistically significant outcomes favoring DUI court

treatment and control groups (Eibner et al., 2006). The researchers randomly assigned second- and third-time DUI offenders to a business-as-usual approach or an enhanced approach referred to as a DUI court. For second-time DUI offenders, the only difference between the treatment and control groups were that those in the treatment group served 2 weeks on electronic monitoring

and breath alcohol testing in lieu of a 4-day jail sentence, and had an alcohol assessment requirement; the control group served the 4-day jail sentence, and did not have an alcohol assessment requirement. Both the treatment and control groups paid the same fines or penalties, completed the state required alcohol program, had a “do not drink” order, and did not serve community service. Thus, there were no differences in the amount of alcohol education, exposure to the judge, or supervision among second-time DUI offenders. For third-time DUI offenders in Los Angeles, the treatment group served 30 days of their 120-day jail sentence in jail, with the remainder on electronic monitoring and breath alcohol testing, while the control group served the entire sentence in jail (or whatever portion was served given jail overcrowding). The treatment group was also ordered to attend 3 months of treatment, although attendance and completion were not monitored, and the control group was not so ordered. Lastly, the treatment group saw the judge five to seven times throughout their sentence as opposed to three to four times for the control group. In short, for third time DUI offenders in Los Angeles, the differences in implementation between the treatment and control group was two to five appearances before the judge, serving 110 days on electronic monitoring instead of in jail, and being ordered to 3 months of treatment.

For the study conducted in a mid-western state (Bouffard and Richardson, 2010), three key elements were missing. There was no judicial component, no collaborative team, and no immediate sanctions and rewards issued by the judge. DUI offenders were seen by probation officers in the state corrections department. In other words, there was no “court” in their “DUI court” process. This is particularly troubling if we can extrapolate drug court findings to DUI courts; specifically, the interactions with the judge have been identified in a recent multisite evaluation of drug courts to be the most important predictor of positive outcomes (Rossman et al., 2011).

In both the MacDonald et al. (2007) and Bouffard and Richardson (2010) studies, statistical analyses resulted in no significant differences between the treatment and control or comparison groups. In both studies, the authors suggest that DUI courts may not be effective. However, the implementation process would suggest that neither of these studies examined DUI courts as they have been defined, but rather examined an enhanced or somehow different case processing. Taking a broader view, both of these studies could argue for the lack of effectiveness of DUI case processing when key components expected in DUI courts are missing; that is, a coordinated team approach that includes active involvement of a judge and a strong emphasis on addressing alcohol use through monitoring and treatment as a means to reduce recidivism and improve public safety (Huddleston and Marlowe, 2011).

Taking a closer look at the five studies with statistically significant results in favor of the DUI court approach, four out of five courts implemented all five core implementation strategies of DUI courts (Georgia, Arizona, Michigan, and Orange County, California), with the fifth being the exception (Oregon). Lapham et al. (2006) does not refer to the Oregon court as a DUI court, but describes the court as a court-based intervention. The Oregon court is consistently referred to as a DISP (a DUI Intensive Supervision Program). Its elements reflect a stronger supervised probation element than a judicial element. While it is a collaboration across government divisions (probation and the courts), there is no collaborative team administering case management decisions or determining sanctions and rewards. The implementation of the Oregon court is markedly different than the other courts in several other ways. First, it is 3-years in length, with a prescribed implementation strategy throughout that period. Most DUI courts are approximately 1 year in length. Second, primary supervision appears to be monthly office

meetings with a probation officer, and only twice-yearly hearings with the judge; thus, judicial interaction for sanctions, rewards, and case monitoring is much less of an emphasis. Other differences include the requirement that DUI offenders must sell their vehicles, and take regular polygraph tests. The Oregon DISP has been extensively evaluated and appears to be successful in reducing subsequent DUIs, but it appears to be a somewhat different process than the DUI–DWI court process.

Study designs and results are shown for the nine studies in Table 2. Several challenges with analyzing findings across studies are immediately noticeable and are typical of court studies and recidivism analyses (Maltz, 1984; Rempel, 2005).

TABLE 2 DUI Court and Court-Based DUI Study Designs and Results^a

Study	Outcome	Follow-Up Interval	Comparison Group	Result
Bouffard and Richardson, 2010: Midwestern states	Any re-arrest	1-year post-program completion	Matched comparison group of parolees	33% among court completers vs. 46.7% among parole completers (ns)
	DUI arrest			17.9% among court completers vs. 6.7% among parole completers (ns)
*Breckinridge et al., 2000: New Mexico	Convictions for alcohol, drug, or other serious offenses	2 years post arrest	RA	15.4% vs. 22.3% ($p < .05$) ^b
Fell, Tippetts, and Langston, 2011: Georgia (3 courts)	Conviction for DUI or alcohol-related offense	4 years post entry	Matched contemporary comparison group	15% vs. 24%, $p < .001$
			Retrospective–historical comparison	15% vs. 36%, $p < .001$
Hiller, Saum and Taylor, 2009: Wisconsin	Any re-arrest	2 years	Waiting list	29% vs. 45% (ns)
	DUI arrest			6.9% vs. 7.8% (ns)
*Jones, 2005: Arizona	Conviction for alcohol-related traffic offense	2 years post-entry	RA to DWI probation	Completers: 3.6% vs. 6.4%, $p < .05$, ES = .13
	DUI arrest	2 years post-entry		4.9% vs. 6.7% (ns)

TABLE 2 (continued) DUI Court and Court-Based DUI Study Designs and Results^a

Study	Outcome	Follow-Up Interval	Comparison Group	Result
*Lapham et al., 2006: Oregon (1 court)	Conviction for DWI	3 to 6 years post entry	Adjudication as usual in neighboring counties, matched on baseline variables	9.8% vs. 18.3%, $p < .01$, ES = .25
	Conviction for driving with suspended or revoked license			14.6% vs. 27.2%, $p < .01$, ES = .31
*MacDonald et al., 2007: Los Angeles	Arrests for alcohol-related offenses	2 years post entry	RA	ns (% not provided)
	Self-reported DUI events			ns (% not provided)
*Michigan AOC and NPC Research, 2008: Michigan (3 courts)	Any arrest	1 year and 2 years	Traditional probation (eligible for DUI / historical)	1 year: Ottawa: 4.3% vs. 15.2% ($p < .01$), ES = .39 2 years: 7.7% vs. 24.2% ($p < .01$), ES = .45. Bay: 17.6% vs. 30.6% ($p < .01$), ES = .30. Clarkston: 4.5% vs. 13.7% ($p < .05$), ES = .32
	DUI arrest			2 years: Ottawa: 0.7% vs. 13.6% ($p < .01$) ES = .57. Bay: 1.2% vs. 6.1% (ns), ES = .29. Clarkston: 2.2% vs. 10.3% (ns), ES = .36
Petrucchi and Ireland, 2008	Any arrest	4 years	Historical	25.1% vs. 42.1% ($p < .01$)
Petrucchi and Ireland, 2008: Orange County Superior Court, California	DUI arrest			9.4% vs. 16.7% ($p < .05$)

NOTE: RA = random assignment; ns = nonsignificant results; ES = effect size; $p > .05$.

^a The format from this table was originally presented in Marlowe et al. (2009). Material for the studies with an * was presented in Marlowe et al. (2009).

^b According to Breckinridge et al. (2000), in Table 5 of their publication, this outcome was found to be statistically significant at the $p < .05$ level using a modification of Fisher's Exact Test to allow for a 3x3 comparison (court group vs. alcoholic control group vs. nonalcoholic group for 0, 1, or 2 convictions). However, in Marlowe et al.'s (2009) discussion of Breckinridge, the 2x2 comparison of the court group vs. the alcoholic control group is presented as nonsignificant. Therefore, we have presented the results as nonsignificant in Table 1.

First, outcomes in DUI courts can be variously defined by arrests or convictions and type of offense (typically any type of offense, driving offenses, and DUI–DWIs). Second, the length of follow-up, including the time in the community with and without supervision, is also important when assessing outcomes. DUI–DWIs are somewhat rare events and longer follow-ups are needed to determine stable outcome patterns. Third, comparison groups also vary in how the comparison group was formed (contemporaneous or retrospective or historical, random assignment or naturalistic, matched or unmatched), and how the results were presented (for completers only or intent-to-treat). Another factor not included in the table that is also important to consider is geographic coverage of the recidivism analyses; meaning, are the arrests from the local jurisdiction only, neighboring jurisdictions, or on a state or multistate level, and which is most appropriate given the geographic location of the court. For purposes of the analysis here and the stage of the research, the factors included in Table 2 are sufficient to assess the current state of the available studies.

In general, the lowest recidivism rates were found for DUI arrests and convictions and higher rates were found for any type of arrest. Comparing the actual percentages further is uninformative due to the different ways that recidivism was measured (arrest, conviction, type of offense) and the different follow-up periods, which ranged from a low of 1 year to a high of 6 years. It is important to understand that the length of a DUI court is typically 1 year with rolling enrollment occurring throughout the year. Therefore, it takes a minimum of 2 years for all DUI offenders who entered the court in the first year to have sufficient time to complete it. Recidivism studies typically include follow-up time in the community to determine post-DUI court improvements, usually a minimum of 12 months. This requires a minimum of a 3-year follow-up period from the time the study begins tracking DUI offender participation. In addition, sample sizes are typically less than 50 per year in a DUI court, requiring at least another year to track a 2-year cohort of DUI offenders through their year-long DUI court plus 1 year in the community. When all is said and done, a minimum of a 4- to 6-year follow-up is needed for a meaningful study of one DUI court that would allow (a) a minimum of 12 months of post-DUI court follow-up for all DUI offenders and (b) sufficiently large sample sizes of more than 50 DUI offenders in each subgroup analysis (those with DUI arrests versus those without DUI arrests, for example). Only the Lapham et al. (2006) Oregon study, the Fell, Tippetts, and Langston (2011) Georgia study, and the Petrucci and Ireland (2008) Orange County study had follow-ups greater than 2 years. Across these three studies, DUI court group arrest or conviction rates for DUI–DWI and alcohol-related offenses ranged from just over 9% to 15% for intent-to-treat samples with comparison groups ranging from 16% to 36% who recidivated; percentage rates for DUI court graduates were lower. More follow-up time across more studies is needed to draw any strong conclusions.

What can be said when examining the results column of Table 2 is that an approximately 10% difference in the recidivism rate between DUI court offenders and the control–comparison group DUI offenders appears to be typical. Marlowe et al. (2009) indicates that this 10% difference may be a reasonable expectation as a definition of success. While it may not sound like much of a difference, given the short follow-up periods, the reasonably small sample sizes, and the fact that a DUI arrest is a somewhat rare event, it is still noteworthy. Longer follow-ups may result in greater percentage differences, as was found in NPC’s 10-year follow-up of drug courts (Finigan, Carey, and Cox, 2007).

Two of the studies were multisite studies, but results indicated a common issue: not all court sites showed favorable outcomes, but sample sizes were insufficient to explain different

outcomes across sites. In the Georgia study, two out of three county courts studied showed statistically significant differences favoring the DUI court participants (Fell, Tippetts, and Langston, 2011). A similar issue was found in the Michigan study in which three county courts were evaluated. In all three court sites, outcomes were in the desired direction with fewer DUI arrests among the DUI court group compared to the comparison groups. However, sample sizes were too small to support statistically significant findings in one of the courts (Michigan State AOC and NPC Research, 2008). It is difficult to know if these differences occurred due to sample size alone or other implementation factors. On an aggregated basis, these differences across courts were washed out.

As it currently stands, these studies would suggest promising evidence that well implemented DUI courts can reduce recidivism and thereby improve public safety. Still, there are several problems with the available DUI court research that future studies can address:

- Small sample sizes hinder the ability to statistically analyze meaningful differences.
- Sample sizes are typically too small to capture potential interaction effects and subgroup differences, such as severity of alcohol use, which could inform practice.
- Longer follow-ups of 4 to 6 years are needed.
- With sufficiently large sample sizes, implementation components then need to be isolated through stronger dosage or “process data,” including sanctions or rewards, and the specifics of treatment, and supervision, to more adequately understand and determine the effectiveness of implementation and the relationship, if any, to outcomes.

RELATIONSHIP OF THE DUI–DWI COURT PROCESS TO ALCOHOL ABSTINENCE

The previous section illustrates that DUI–DWI courts have limited research evidence in applied research settings. However, the abstinence literature lends itself well to a better understanding of the DUI–DWI court process. Harvard developmental alcohol researcher Vaillant’s (1995) longitudinal study on the predictors of abstinence can be linked to several facets of the DUI court process and serve as a framework for understanding how DUI–DWI courts can potentially support abstinence:

1. Vaillant points out those alcoholics who are socially unstable need to be treated among their peers rather than in controlled clinical settings. DUI courts support a peer approach. DUI offenders see the same peer group in their judicial status hearings, treatment, and testing appointments.
2. Vaillant points out the importance of the first 12 months of abstinence. DUI courts typically last a minimum of 12 months, providing key support during this period.
3. He identifies four key nontreatment factors associated with the first year of abstinence. DUI–DWI courts have a direct relationship to one of these: behavior modification through compulsory supervision or sustained confrontation. In essence, this is what occurs during the judicial status hearings, the sanctions and rewards process implemented by the judge, and the other types of supervision utilized in DUI court, including testing, and ongoing contact with treatment and probation staff. Vaillant emphasizes the importance of alcoholics experiencing consequences for their alcohol use as a way to recognize the negative impacts of

alcohol. The sanctioning process in DUI–DWI courts is specifically intended to deliver consequences that accomplish just this (Marlowe and Meyer, 2011).

4. For the remaining three nontreatment factors associated with the first year of abstinence, DUI court activities have an indirect relationship:

a. Develop a substitute dependency for alcohol use. In his discussion of relapse prevention, Vaillant highlights the importance of changing alcohol “from a friend to a foe,” and in doing so, some other activity has to be substituted. Common substitute activities noted in his study sample were working, helping others, smoking, or becoming very involved in Alcoholics Anonymous (AA). Vaillant describes this as the fifth task of relapse prevention based on Marlatt and Gordon’s work (1985): developing substitutes for bad habits. Relapse prevention skills are a standard treatment approach for alcohol and drug use and are commonly used in drug and DUI–DWI courts (Marlowe and Meyer, 2011).

b. Enhance hope and self-esteem, often through either religious involvement or Alcoholics Anonymous or similar self help groups. Drug court and DUI–DWI courts utilize evidence-based practices and best practices such as motivational interviewing and motivational enhancement therapy, cognitive behavioral therapy, relapse prevention, and self-help recovery programs that all include an emphasis on enhancing the positive qualities of offenders, including hope and self-esteem (Marlowe and Meyer, 2011).

c. Acquisition of new love relationships. Vaillant notes that this could take the form of a new spouse, but can also be a healthy relationship with a nonprofessional, mentor or friend. Vaillant noted that for many of the men who maintained abstinence, they had a new stable love relationship or friendship with someone who had not experienced the negative impacts of their alcohol abuse that a long-term spouse or friend would have. These new relationships can sometimes more easily support hope and self-esteem for the alcohol dependent person, and also support positive non-alcohol–related sober activities. The DUI–DWI court experience supports making new positive relationships with other DUI–DWI offenders or with those met in Alcoholics Anonymous or other self-help groups.

5. Vaillant (1995) notes three other important sources of relapse prevention that were not part of his four nontreatment factors:

a. Those who maintain abstinence do so in part by creating a new identity for themselves and publicly announcing their intention to maintain abstinence. In DUI–DWI courts, offenders appear one at a time in front of the judge, the treatment team, and other offenders and spectators in a public court setting and discuss their progress with the judge.

b. Using cognitive strategies for relapse prevention, including positive feedback for successive abstinence. The reinforcement the judge provides on how DUI–DWI offenders are doing through verbal praise is one of the most essential elements of the judicial status hearings (Marlowe and Meyer, 2011). External reminders of the consequences, both positive and negative, of alcohol use are essential to ongoing abstinence. Again, the judicial status hearings that DUI–DWI offenders normally participate in throughout a year-long period allow ongoing reminders on a one-on-one basis, as well as vicariously as they watch others appear before the judge, of the consequences of alcohol use and the positive reinforcers for abstinence.

c. Importance of extinguishing secondary reinforcers for alcohol use in the community. Bars and being around others who drink are secondary reinforcers that can trigger alcohol use. Supervising DUI–DWI offenders while they are in the community and have significant motivation to maintain abstinence due to pending sanctions and rewards of the court are an effective means of extinguishing the potency of these secondary reinforcers. In this way, DUI–DWI offenders are less likely to be negatively influenced by secondary reinforcers after they are no longer under supervision.

This brief review of the relationship between Vaillant’s abstinence research and DUI–DWI court implementation was intended to illustrate the overlap between best practices to maintain abstinence and the implementation structure of DUI–DWI courts. The public nature of the court, the 12-month length, the behavior modification strategies, and the exposure to relapse prevention and other evidence based programs all have significant potential to support abstinence of DUI–DWI offenders.

SANCTIONS AND REWARDS IN DUI COURT RESEARCH

If little is known about the process and outcomes of DUI courts, then even less is known about the specific process of sanctions and rewards. This section will outline current thinking and the very limited research on the sanctions and rewards process in DUI courts. The sanctions and rewards process, typically carried out by the judge in collaboration with the court team that includes attorneys, law enforcement, probation, and treatment professionals, is believed to be among the most important of the drug court, and by extrapolation, the DUI–DWI court process (Marlowe and Meyer, 2011). This is because it is so closely tied to relapse, which is believed to be an expected occurrence when dealing with alcohol or drug use (Hser, Longshore and Anglin, 2007). Addressing relapse through close monitoring and supervision is an essential component to reducing the risk of future episodes of drinking and driving (Nochajski and Stasiewicz, 2006).

The essential components of sanctions and rewards follow the psychological literature on operant conditioning and the deterrence literature very closely (Marlowe and Meyer, 2011). Simply put, DUI–DWI offender behavior must be monitored closely, with clear boundaries of what is and is not acceptable. Immediate rewards for accomplishments and sanctions for infractions are issued as a means to reduce antisocial behaviors and reinforce pro-social behaviors. Key elements needed for this process to be successful include reliable, accurate monitoring of offender behavior followed by immediate and certain consequences. Another important element is the magnitude of the sanction or reward. Sanctions and rewards that are too small can be too easily ignored. Those that are too severe can cause negative side effects or be impractical. Intermediate sanctions and rewards that can be gradually increased or decreased (graduated) are thought to be the most effective. Another important element of sanctions and rewards is fairness, including the offender’s perception of fairness. The procedural justice literature has shown that defendants will be more likely to accept a decision if they believe it was administered fairly. Other key elements in procedure fairness that are in line with DUI–DWI court practice include offenders being able to voice their own side of the story, offenders being treated in a similar manner as others in similar circumstances, and offenders being provided dignity and respect in the sanctions and rewards process (Tyler, 1994; Marlowe and Meyer, 2011).

Fairness does not have to be interpreted to suggest that the same sanctions should be used for the same behavior across individuals. Another key aspect of sanctions and rewards is that they are individually determined for each offender's circumstances. The severity of alcohol use can vary such that when someone who is severely dependent remains abstinent for 7 days, a reward of greater magnitude may be in order compared to the less-severe alcohol abuser who ostensibly has an easier time maintaining sobriety for 7 days. Individual sources of variation in how the sanction and reward will be experienced should be considered. More specifically, what does the sanction or reward mean to the person experiencing it? What are their expectations and past experiences with it? For example, someone who has never been to jail will be far more impacted by a short jail stay than someone who has spent significant amounts of time in jail. Consequences of the sanction should also be considered. Following the jail analogy, if an offender is the primary caregiver for minor children and receives a jail sanction, the impact could be more significant than an offender without minor children. The same sanction may not be equal across individuals, based on their individual circumstances, expectations, and the consequences of that sanction. Potential sources of variation, such as age, gender, employment status, socioeconomic status, level of comfort with incarceration, and severity of alcohol use should each be considered when designing and administering sanctions and rewards.

Last, effective sanctions and rewards should be designed to address proximal (easier) and distal (more difficult) goals. Proximal goals are those that offenders can more easily accomplish that help them toward the more long-term goals. Attendance at judicial status hearings or treatment sessions is an example. Distal goals are more difficult to achieve. For the alcohol-dependent offender, prolonged abstinence may be a distal goal. Higher-magnitude sanctions are more effective with proximal (easier) goals, and lower-magnitude sanctions are appropriate for distal (more difficult) goals. In this way, offenders will not ignore the easier goals that they did not accomplish, but also not become discouraged when they fail at distal goals. Reaching the proximal goals will help them to eventually attain the distal goals. The converse is true for rewards. Lower magnitude rewards are appropriate for proximal (easier) behaviors, and higher magnitude rewards are appropriate for distal (harder) behaviors (Marlowe and Meyer, 2011).

An understanding of sanctions and rewards begins with a clear understanding of their purpose in a DUI court setting. Sanctions and rewards in the DUI–DWI court process can have one of three goals:

- To prohibit driving;
- To prohibit drinking; and
- To prohibit both driving and drinking.

In drug court jargon, sanctions and rewards are typically approached from a legal and treatment perspective. If the behavior exhibited by the DUI offender was a legal issue (such as driving on a suspended license), then the sanction response should address that legal issue rather than a drinking issue. At the same time, if a DUI offender is found drinking, then the sanction should specifically address the drinking, such as adjusting the treatment plan or requiring attendance at AA meetings, rather than having a legal focus, such as ordering a jail stay. If both driving and drinking occurred, then the sanction should be matched to both the legal and the treatment issues.

A list of graduated sanctions and incentives are typically developed in DUI–DWI courts to meet the needs of their particular population. For example, in the Michigan study, sanctions included (Michigan AOC and NPC Research, 2008):

- Increased supervision,
- Electronic monitoring,
- Increased substance use testing,
- Community service,
- Jail alternative work service,
- Loss of driving privileges,
- Admonishment,
- Delayed movement to a new phase,
- Extended time in the program,
- Writing an essay on an assigned topic related to the infraction,
- Verbal or written apologies, and
- 48-h to 30-day jail sentences.

A typical list of rewards or incentives were (Michigan AOC and NPC Research, 2008)

- Positive recognition from the judge,
- Team applause and praise,
- Court fines reduced or payment plan extended, and
- Certificates and gift cards for advancing to a new phase.

A variety of sanctions and rewards are typically used to address individual circumstances of DUI–DWI offenders. The Georgia study presented the percent of participants who received their sanctions and rewards (Fell, Tippetts, and Langston, 2011). The percent of offenders who received each sanction included

- 29% jail;
- 26% increased community service;
- 13% other;
- 10% curfew;
- 6% verbal reprimand;
- 4% more intense level of treatment;
- 2% work release;
- 2% increased 12-step meetings;
- 1% increased drug testing; and
- 1% increased probation supervision.

The percentage of offenders who received incentives or rewards was as follows:

- 25% credit for community service;
- 18% recognition from the judge in a court session;
- 14% waiver of assessment or intake fee;

- 14% reduction in jail time;
- 14% reduction in house arrest type; and
- 10% certificate of accomplishment.

Capturing process or implementation data of any type in DUI–DWI courts is a current significant shortfall of the existing available evaluation research. Documenting sanctions and rewards specifically is even rarer. No dosage or process data of any kind was reported in 79% of the DUI court evaluation studies reported in Marlowe et al.’s (2009) review of 14 studies. Among studies that did report dosage data, one study reported one type of service, and two studies reported three types of service (counseling, court hearings, and biological tests for substance use). Moreover, the MQS used in the systematic review did not include sanctions and rewards in the definition of dosage of services.

The Michigan study included sanctions in regression analyses to predict recidivism (Michigan AOC and NPC Research, 2008). In the Ottawa County DUI–DWI court, a higher number of sanctions predicted earlier arrest, and program graduates averaged a lower number of sanctions, with 3.31, compared to 7.3 average sanctions among program terminators. In the Bay County court, however, the number of sanctions did not predict earlier re-arrest. Graduates also had an average of 3.3 sanctions, while program terminators had an average of 9.7. These findings may seem somewhat self-evident, but one important note is that even those who go on to successfully complete DUI–DWI court receive sanctions. In the Orange County study, for example, over half (52.7%) of DUI–DWI offenders received at least one sanction, and 66% successfully completed the program. This suggests that some number of graduates received sanctions (Petrucci and Ireland, 2008).

To adequately capture the sanctions and rewards process in evaluation research, resources need to be allocated for what is usually labor-intensive data collection. Even basic counts of sanctions and rewards are an onerous task, particularly if each sanction and reward is linked to an individual. But if we are to understand the impact of sanctions and rewards, then quantitative documentation as well as qualitative observation and mixed methods analyses of the sanction and reward process are essential ingredients for future evaluation studies. The perspective of DUI–DWI offenders is also important in ascertaining the meaning of the sanction and reward to them as another important facet of understanding their potential effectiveness, or lack thereof. Given that as many as half of DUI–DWI offenders may not receive a sanction, categorical data analyses may also be important in learning the characteristics of offenders who do not receive sanctions (or rewards), rather than means testing approaches. Moreover, the temporal order of sanctions and rewards may be another important analysis, and their relationship to abstinence, graduation, and recidivism. These are time consuming sophisticated analyses that can potentially render valuable understanding of whether and how the sanctions and rewards process in DUI–DWI courts contributes to their effectiveness.

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Revisiting the Framework for an Integrated Model

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At the conclusion of the presentations, several speakers were asked to provide comments on the integrated model and guidance on how these pieces might fit together. Paul Marques was asked to provide comments on how technological components and the ability to provide monitoring and feedback to treatment providers would fit in with the model. David DeYoung provided the perspective of a research practitioner, and Richard Vlavianos, a judge with the Superior Court of California, was asked to provide the judicial perspective. Finally, Kathryn Stewart provided a wrap-up of the workshop findings. [Note: Opinions expressed and provided below are those of the speaker and are not endorsed by the committee or by TRB.]

TECHNOLOGIES TO MONITOR ALCOHOL-INVOLVED DRIVERS

Paul R. Marques, *Pacific Institute for Research and Evaluation*

The following points were made by the speaker:

- There is a need to parse the difference between change that is imposed and change that is chosen. But judges can help people “volunteer” and it is the program’s job to motivate them. Moreover, he indicated that Michigan judges are using biomarkers as indicators of alcohol use.
- There is some evidence that interlocks can be used for greater control over drinking. This opens the capability to use different sanctions or countermeasures in sequence. For example, in Indiana there is a judge who has used house arrest for those who claimed they do not have a car and thus could not install an interlock. While sanctions should meet the needs of the individual, judges like to have flexibility. One example is the use of probation before judgment in Maryland. Offenders are required to go through the process with a judge and is backed up by weekly meetings with a person who monitors progress. If offenders have accomplished their goal in a year, the original charge is dropped.
- Despite assessments and individual tailoring of sanctions, the speaker expressed the belief that it is important that everybody gets an interlock.
- Impaired driving is imbedded in a wider problem complex. There is a need to take a broader look at what is going on. It may not be sufficient just to deal with problem drinking but a tiered approach may be needed. The key to successful flow through the system and appropriate treatment is an efficient screening mechanism. DUI courts are a first step.
- Low risk–low need offenders might respond positively to ignition interlocks; 10% to 35% of offenders never blow a failed breath test.
- There are some questions that need to be addressed. What is the problem we are trying to address? What is the service we are providing? Does the service address the problem we are trying to solve? Does the interlock really address the problem we are trying to address? An interlock is only part of the sentence. DUI courts have subsequent sanctions.

- Europeans use alcohol biomarkers to give an initial sense of what is going on with offender in terms of drinking patterns. Are there barriers in the United States to using biomarkers?
- Some people really are one-time offenders. There is resistance to using biomarkers for those offenders. Behavior should drive the response and this starts at a different point for second offenders.
- Are we addressing drinking or drinking and driving? Biomarkers only address drinking. But there are tests that can also be used with younger drinkers who may not have an extended drinking history.
- Various questions from the workshop attendees addressed the cost of biomarker testing. The speaker indicated that costs are around \$50 to \$100 per test. Judges can order it and offenders can be required to pay for it. If they cannot pay for it that is hard to deal with, unless there is a funding source.
- The North Dakota 24/7 program costs \$2 per day for a breath test. They also have patches for drug use.
- Assessment should be a dynamic, ongoing process. One issue is that cognitive problems often are missed.
- Another question concerned the cost of other monitoring devices? Transdermal devices are expensive. Nonvehicle interlocks are a possibility.
- Judges react to behavior—home confinement or whatever sanctions are imposed are contingent on behavior—either while on probation or based on previous offense record. Judges need a range of choices that they choose from depending on offender behavior.
- There are often mental health issues associated with drinking and driving. Most people doing assessments are narrowly trained. They do not have the skills to undertake a wider assessment. That being said, there a lot of standardized assessment tools that can be used by paraprofessionals or even self-administered.
- There is a distinction between screening and assessment. If offenders are messing up that illustrates the need for a more complete assessment.

INTEGRATED MODEL: A RESEARCH PERSPECTIVE

David J. DeYoung, *California DMV*

The following points were made by the speaker:

- Researchers and practitioners should look at weaknesses in sanctions. The California DMV is looking at recidivism curves in California and making significant progress in recidivism.
- Some countermeasures or sanctions are based on evidence and others are just historically based. There is the hope that in the mix, there will be something that will work for each offender. However, not much is known about what will work for whom.
- On evaluating specific measures, the most effective sanction for traffic safety is license suspension. However, not much is known about the appropriate term. Researchers should look at the evidence base with respect to length of suspension.
- Are there therapeutic benefits from enforced abstinence? Interlock experience indicates that is not the case.

- Does jail work? The evidence does not support that but one serious shortcoming when studying this sanction is that we do not really know if people actually serve their jail sentences.
- Other questions that need to be addressed include: Do vehicle-based sanctions have general deterrence effects? Is vehicle forfeiture more effective than vehicle impoundment? For all sanctions: are they more effective with specific subgroups?
- Alcohol programs should be examined more carefully. Education programs have not been looked at for decades and efforts have not been made to improve on them. They are a required component in many DUI systems and they should be of better quality.
- There are not many controlled evaluations of DUI courts, thus we do not really know much about their effectiveness, for whom they are used, and what are the elements.
- With regard to the use of pharmaceuticals: we do not know much about effectiveness and for whom they are appropriate.
- How can we efficiently screen out the high need and high risk offenders? Some groups have crossover into other criminal activities.
- When conducting evaluations researchers should consider both process and outcome components, that is, both efficacy and effectiveness measures. Black box evaluations may not be sufficient. For example, we do not know why some people do not install interlocks.
- There is significant scientific evidence that interlocks curb impaired driving incidents. What does it mean that you have 65% effectiveness but only a 15% rate of installation?
- Researchers should consider goal-free evaluations. That is, they should look at entire effects, not just a designated goal. Interlocks cut recidivism but there are other effects, e.g., they can increase overall crash rates compared with offenders with suspended licenses who drive fewer miles.
- Researchers should take a social ecological systems perspective. Driver license reinstatement has been tied to a requirement for interlocks, but there may also be a requirement you also have to enter a DUI program. What is the impact on the system? Will participation in DUI programs decline?
- Data system needs. Some knowledge gaps result from data limitations. For example, it is unknown how many vehicles are impounded and how many interlocks are installed. Data systems are designed to do the business of the DMV but are not designed for integration and research.
- DUI laws are very complex. Some noncompliance may be due to confusion. Integrated programs will require yet more laws. Researchers need to be advocates.
- Researchers should keep an open mind and be open to changes in the research findings. There is also a need to impart that to legislatures.
- New countermeasures should be implemented as pilot programs, and include an evaluation mandate with sunset clauses. One respondent pointed out that sunset clauses can backfire. For example, in spite of evaluations that indicated their effectiveness, speed camera programs in Arizona were terminated. Another example of negative effects of sunset laws can be found in Oregon. Special license tags for offenders' vehicles were found to be effective, but the law was still terminated.

MULTI-TRACK SYSTEM OF COURT INTERVENTION IN DUI CASES

Richard Vlavianos, *Superior Court of California*

Vlavianos pointed to the importance of good information and communication in DUI cases. He stressed the need to collect the essential information and communicate it to the people who are tasked with making appropriate decisions. He also indicated that the court system is a multitrack with DWI courts being just one of the tracks in a larger system.

There are several areas of potential court intervention. One is during the pretrial phase and includes conditions of bail or release and could include an interlock or monitoring requirement. Post-conviction interventions include conditions of probation or post-supervision release conditions including monitoring. There is judicial discretion about which course to follow with an overriding need to protect the safety of the public. The judicial role is an important aspect. The judge is the person in charge and the recognized authority, akin to a parental role. When it comes to changing behavior, perception is everything. If the perception is that the judge is uninvolved or does not care there can be a more negative outcome. On the other hand, if the perception is that the judge is involved and cares about the offender there is likely to be a much more positive outcome. The judge should monitor progress carefully, just as parents would. There are quite a large number of judges who fall under this model. For example, the National Association of Drug Court Professionals, drug court judges, and DUI court judges.

Various tools are needed. First are accurate assessment tools to support evidence-based practices. There are different groups of offenders, and these groups vary in the risk of recidivism. For example, addicted offenders are high risk and have high needs. Such offenders may need to be referred to DUI court and treatment. Substance abusing offenders can be antisocial and resistant to change. In this case, monitoring may be more important than treatment. The overriding principles are that you should keep them separate and not over-treat people who have lesser needs.

Traditional DUI courts are designed for addicted offenders who need intensive treatment and intensive court supervision. But numbers in any one court system should be kept low (75 to 100 participants). DUI courts appear to have experienced great success rates, but there is a need for more, stringent evaluations to validate the approach.

One issue is that there are 800 to 900 repeat offenders per year in the San Joaquin County, California, area so DUI courts cannot possibly handle all of them. Different approaches are needed to address the broader group, some of whom need lesser interventions. In San Joaquin there are two tracks. For substance abusers, one is the monitoring track. There is the same accountability to the court and the same judge is involved at each stage. A case manager is assigned and the court reviews at 1 month, 6 months, and 1 year. Compliance with sanctions is monitored and consequences for not adhering to the sanctions can be certain and immediate. Conversely, there should be positive encouragement when progress is made. The second track is the DUI court (130 cases). Assessment and treatment is a required along with more frequent court visits.

Available information suggests that these approaches have been successful. Although no formal study has been conducted, alcohol-related deaths and injuries and recidivism all have declined by about 50% since the inception of the program. In addition many more offenders are completing education program—up from 29% to 89%. The number of alcohol ignition interlocks installed on vehicles also has gone up. Also, workload has actually decreased with first offenders down 22% and second offenders are down 18%.

WHAT CONCLUSIONS CAN BE DRAWN FROM AVAILABLE RESEARCH AND EXPERIENCE? WHAT ARE THE REMAINING RESEARCH NEEDS?

Kathryn Stewart, *SPAI*

The topic of this workshop is how best to deal with those offenders who have been apprehended and, in most cases, convicted of alcohol impaired driving. Drivers with a previous DUI offense are four times more likely to be an intoxicated driver in a fatal alcohol-related crash (Fell, 1992) than drivers without an offense. Fatal crashes involving drivers with a DUI conviction in the last 3 years account for 1,000 fatalities a year (NCSA, 2006). Clearly, these drivers are dangerous even though they only account for a small proportion of serious crashes. In addition, they attract a great deal of public and legislative attention and make high demands on the judicial and traffic safety systems. Having an efficient and integrated system for administering effective sanctions to these offenders can improve the operation of the whole system, preventing some crashes and conserving resources.

Presentations in the course of the workshop have pointed out four general goals for the sanctions meted out to impaired driving offenders:

1. Deterrence: a sanction that is sufficiently swift, certain, and onerous as to discourage the general public from drinking and driving;
2. Retribution: administering some punishment that expresses society's disapproval of the illegal act and exacts some penalty to satisfy a desire for justice;
3. Incapacitation: preventing the offender from repeating the offense by limiting their ability to engage in illegal behavior, thus preserving public safety; and
4. Rehabilitation: bringing about long-term changes in the behavior of the offender by addressing the underlying problems that led to the offense.

Each of these goals involves different sorts of sanctions that may be administered by different agencies and organizations. Coordinating these various aspects of the sanctioning system poses challenges. Moreover, these goals may sometimes be at odds with each other. For example, rehabilitation might argue for more freedom to drive, in contrast to the goal of incapacitation in the interest of greater public safety.

Attitudes towards impaired driving have undergone an evolution in the United States and many other countries. For decades, drinking and driving was viewed with a mildly indulgent attitude, the assumption being that most people engaged in this behavior at least occasionally and that crashes were the result of bad luck and could happen to anyone. With the rise of the victims movement, spearheaded in the United States by Mothers Against Drunk Driving (MADD), the public began to recognize that alcohol-impaired driving was an illegal act that needlessly endangered other road users. MADD fostered anger against drunk drivers and emphasized that they were heedless criminals. Over time, MADD's message shifted and public attitudes changed to recognize that society as a whole fostered impaired driving through laws, policies, and social norms and behavior. This led to strategies to address these underlying problems, for example, controls on alcohol sales and raising the drinking age limit.

The complicated evolution of goals, attitudes and policies has led to a system that includes regulations, laws, processes, and goals that are sometimes at odds with each other and which are difficult for offenders, courts, licensing agencies and service providers to navigate and manage. This is all occurring at a time when resources are scarce. Inefficiency and redundancy

can lead inevitably to potentially dangerous neglect as budgets and staffing of key agencies are cut. Recent years have brought the development of technologies with the potential for augmenting traditional approaches to incapacitation and rehabilitation. These technologies bring valuable tools to the system but also create further expenses and complications.

Existing research can guide efforts to streamline this system and optimize the handling of different kinds of offenders. At the same time, it is important that changes be economically feasible and acceptable to the general public. Additional research will be needed to evaluate and refine the changes that are made.

APPENDIX A

Conference Agenda

**Transportation Research Board
Committee on Alcohol, Other Drugs and Transportation
Summer Workshop, August 15–16, 2011**

**National Academy of Sciences Beckman Conference Center
Irvine, California**

A number of strategies have been used to reduce reoffending among impaired drivers. These include sanctions intended to separate drinking from driving, sanctions that incapacitate offenders so that they cannot drive or cannot drink or cannot combine the two, and education and rehabilitation to reduce drinking problems and impaired driving. Some of these sanctions have also been shown to have a significant general deterrent impact. Although all of these strategies have shown some level of success, they are often applied haphazardly and enforced poorly. In addition, little is known about how these various approaches can be combined for maximum efficiency and effectiveness. This workshop is designed to bring together researchers and policy makers to discuss the current state of our knowledge about how best to deal with impaired driving offenders and to work towards an integrated model that can have the maximum effect on safety.

MONDAY, AUGUST 15, 2011

7:15 a.m.–8:15 a.m. Breakfast at Beckman Center

8:15 a.m.–8:30 a.m. **Introduction**

8:15 a.m.–10:00 a.m. **Framework for an Integrated Model**
Speaker: Bob Voas

This session will highlight the various strategies currently available for rehabilitation, incapacitation, and punishment of impaired-driving offenders. It will discuss existing gaps and lack of coordination and ways in which it might be possible to improve on the effectiveness of the current system through the application of one integrated model to deal with impaired drivers.

10:00 a.m.–10:30 a.m. Break

SANCTION COMPONENTS

For each component, presentations will provide evidence on effectiveness, possible reasons why it is not 100% effective, and what is needed to enhance overall effectiveness. Speakers will also

include information, where available, on differential effects of sanctions on different offender populations and on general deterrence.

10:30 a.m.–Noon **Vehicle-Based Sanctions**

Breath-alcohol ignition interlocks: As more states have passed laws to require alcohol ignition interlocks, including for first-time offenders, what is the evidence for their effectiveness, what are the shortcomings in current practices, and what approaches or components seem to work better (including how to get them on more driving-while-intoxicated offender's vehicles and effective application and monitoring practices)?

10:30 a.m. **Overview of Effectiveness Including Research on
1st Offender Laws**
Speaker: Randy Elder, CDC

11:00 a.m. **Plate and Vehicle Impoundment and Special License Tags**
Speaker: Dave DeYoung, California DMV

11:30 a.m. **Discussion**

Noon–1:00 p.m. Lunch

1:00 p.m.–3:00 p.m. **Driver-Based Sanctions**

1:00 p.m. **License Suspension–Revocation–Incarceration**
Speaker: Dave DeYoung, California DMV

1:30 p.m. **Monitoring, Including House Arrest and Alcohol
Monitoring, Including Biomarkers**
Speaker: Paul Marques, PIRE

2:00 p.m. **Discussion**

3:00 p.m.–3:30 p.m. Break

3:30 p.m.–5:00 p.m. **Rehabilitation**

3:30 p.m. **Screening, Assessment, and Treatment, Including
Brief Interventions**
Speaker: Carlo Diclemente, University of Maryland, Baltimore County

4:00 p.m. **DUI Courts**
Speaker: Carrie Petrucci, California State University, Long Beach

DUI courts have the potential to integrate all of the sanction–intervention types as well as to add an element of monitoring.

4:30 p.m. **Discussion**

5:30 p.m.–7:30 p.m. **Reception**, Hyatt Regency Newport Hotel

TUESDAY, AUGUST 16

7:15 a.m.–8:15 a.m. Breakfast at Beckman Center

8:15 a.m.–10:00 a.m. **Revisit the Framework for an Integrated Model**
Speakers will provide comments on the model and provide guidance on how these pieces might fit together:

8:15 a.m. **Opening Remarks**

8:30 a.m. Paul Marques will provide comments on technological components and the ability to provide incapacitation monitoring, feedback to treatment providers, and using data to craft interventions.

9: 15 a.m. Dave DeYoung will provide the perspective of a research practitioner.

10:00 a.m.–10:30 a.m. Break

10:30 a.m.–Noon

10:30 a.m. Richard Vlavianos will provide the judicial perspective. Judges are given a wide array of options and must work within a strained system.

11:15 a.m. **Overall Discussion**
What conclusions can be drawn from available research and experience? What are the remaining research needs?
Moderator: Kathryn Stewart

APPENDIX B

Conference Participants

Erin Beasley
Beirness and Associates, Inc.
Ottawa, Ontario
Canada

Ray Bingham
UMTRI
Ann Arbor, Michigan

Steven Bloch
Auto Club of Southern California
Costa Mesa, California

Paul Boase
Transport Canada
Ottawa, Ontario
Canada

Debra Coffey
Smart Start, Inc.
Irving, Texas

Felix J. E. Comeau
ACS Corp.
Toronto, Ontario
Canada

Richard Compton
National Highway Traffic
Safety Administration
Washington, D.C.

Denise L Connerty
ACS Corp.
Toronto, Ontario
Canada

Carlo DiClemente
University of Maryland, Baltimore County
Baltimore, Maryland

Angela Eichelberger
Insurance Institute for Highway Safety
Arlington, Virginia

Randy Elder
Centers for Disease Control and Prevention
Atlanta, Georgia

Ronald Engle
The Century Council
Arlington, Virginia

Susan Ferguson
Ferguson International LLC
Naples, Florida

James Frank
ACS Corp.
Toronto, Ontario
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Peggy Hora
National Highway Traffic
Safety Administration
Walnut Creek, California

Christopher Kuhn
The Century Council
Arlington, Virginia

Ian Marples
Smart Start, Inc.
Irving, Texas

Jane Maxwell
Addiction Research Center
Austin, Texas

Brandie McCuen-Burgos
Iowa Department of Transportation
Ankeny, Iowa

Marie Claude Ouimet
University of Sherbrooke
Longueuil, Quebec
Canada

Richard F. Pain
Transportation Research Board
Washington, D.C.

Carrie Petrucci
EMT Associates, Inc.
Encino, California

Mark Rosekind
National Transportation Safety Board
Washington, D.C.

Jean Shope
UMTRI
Ann Arbor, Michigan

Anthony Stein
Safety Research Associates, Inc.
La Canada, California

Kathryn Stewart
SPAI
Lafayette, California

David Timken
Center for Impaired Driving
Research and Evaluation
Boulder, Colorado

Richard Vlavianos
Superior Court of California
Stockton, California

Robert Voas
PIRE
Calverton, Maryland

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