



Traffic Safety and Alcohol Regulation: A Symposium

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**Traffic Safety and
Alcohol Regulation**

A Symposium

June 5–6, 2006
Irvine, California

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Traffic Safety and Alcohol Regulation

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Foreword

Reduction of alcohol-impaired driving can be considered from both sides of the problem: how to reduce traffic problems and how to reduce alcohol impairment. A variety of alcohol control and regulation strategies have been found to reduce alcohol impairment among drivers. In order to review and synthesize many of the most promising strategies in alcohol regulation, the Alcohol, Other Drugs, and Transportation Committee of the Transportation Research Board (TRB) convened a workshop to discuss the role of alcohol regulation in traffic safety. The workshop was held June 5–6, 2006, 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 as well as the background papers prepared for the workshop.

ACKNOWLEDGMENTS

This symposium was organized by TRB's Alcohol, Other Drugs, and Transportation Committee (ANB50). The symposium was made possible in part by the support of the NHTSA, Transport Canada, and the Pacific Institute for Research and Evaluation. The workshop was also cosponsored by the International Council on Alcohol, Drugs, and Traffic Safety.

Many members of the committee worked to make this event possible and successful. A sincere thank you is extended to each of them. Kathryn Stewart led the organization and planning of the symposium and then compiled this circular. A most grateful thank you to Kathryn for her dedication and endurance.

Overview and Summary

KATHRYN STEWART

Safety and Policy Analysis International

INTRODUCTION

Alcohol-impaired driving is a major threat to traffic safety. Considerable progress has been made in recent decades in countries throughout the industrialized world. In the last several years, however, this progress has stalled, and in some countries, progress has eroded. In the United States, in 2005 almost 17,000 people died in alcohol-related crashes. That number has been virtually unchanged for the past decade.

Well-known and effective approaches to impaired driving involve enforcement and deterrence to keep drinkers from driving. Another set of promising strategies attempt to reduce alcohol consumption through regulation of the sale and service of alcohol and thus make it less likely that potential drivers will drink enough to be impaired. The most well-known alcohol regulation that has made a major contribution to traffic safety has been the establishment of 21 as the drinking age throughout the United States. By reducing alcohol consumption among immature and inexperienced drivers, tens of thousands of traffic fatalities have been prevented. Other alcohol regulatory strategies can make alcohol more expensive or reduce its availability in risky situations.

In order to provide a systematic review and synthesis of the many regulatory strategies that have been implemented and evaluated, the Transportation Research Board's Alcohol, Other Drugs, and Transportation Committee convened a workshop to discuss the role of alcohol regulation in traffic safety. The workshop was held at the National Academies' Beckman Conference Center in Irvine, California, June 5–6, 2006. This report provides an overview of the information presented and the discussions among the participants as well as the background papers prepared for the workshop.

BACKGROUND AND STRUCTURE OF THE WORKSHOP

National surveys consistently show that alcohol is by far the most frequently used and abused drug in the United States (Johnston, Bachman, and O'Malley, 2002; Substance Abuse and Mental Health Services Administration, 2003). In 2005, alcohol was involved in 39% of traffic fatalities in the United States. Alcohol is also implicated in a host of other health and social problems (e.g., dependence and alcoholism, cirrhosis, fetal alcohol syndrome, assaults, child and spousal abuse and neglect, homicide, suicide). Alcohol regulatory strategies have been shown to have an impact both on traffic safety and on other alcohol problems. Regulatory strategies have been implemented at many different points in the alcohol sales and service system and have varying levels of research and evaluation support. Alcohol regulation raises many issues regarding economic interests and governmental control of commerce.

This workshop provided an opportunity for experts in this field to summarize and synthesize the large volume of evidence related to the impact of these strategies on traffic safety, to highlight the most promising strategies, and to identify gaps in our knowledge.

The workshop was attended by committee members, other researchers, and government policy makers. Attendees came from five different countries. A list of attendees appears in Appendix B.

Background papers were prepared by researchers on key topics. Authors of the papers made brief presentations followed by general discussion. Topics covered in the workshop were

- Overview of alcohol regulation and its impact on traffic safety;
- Alcohol price controls and traffic safety;
- The legal framework for alcohol regulation;
- Alcohol regulation and the European Union (EU)—effects on road safety;
- Alcohol policies in Latin America and the Caribbean;
- Minimum purchase age laws:
 - History, contrasts, and erosion,
 - Case study: New Zealand lowers drinking age, and
 - Status of 14 drinking age laws in the United States;
- Limits on outlet density and location;
- Limits on hours of sales/service;
- Dram shop and social host liability laws;
- Responsible beverage service practices, feasibility, and utility;
- Enforcement of alcohol regulation: agencies, methods, impact;
- Enhanced enforcement of laws prohibition sale of alcohol to minors; and
- The importance of alcohol regulation at all levels: Bringing it all together.

The complete agenda of the workshop is included in Appendix A. The background papers appear in the body of this circular.

OVERVIEW OF THE DISCUSSIONS

The workshop was designed to review and synthesize research pertaining to the various forms of alcohol regulation and their impact on traffic safety. The background papers and discussions helped to identify the most promising strategies—but also the complexities and barriers confronted in evaluating and implementing the strategies.

Following is an overview of some of the major themes raised during the discussions. More detail on each topic and relevant references can be found in the background papers in the body of this circular.

The Nature and Role of Alcohol Regulation

Alcohol is a legal product regulated by law, therefore, there are many mechanisms that can be used to control its price and the way it is promoted and made available for sale or consumption. Availability and promotion of and access to alcohol can be controlled by government at the federal, state, and local levels through laws and policies. Controls can also be imposed at the level of the individual sales establishment. Most of these regulations are established for reasons unrelated to traffic safety (for example, to raise revenue through taxation), but their impact on traffic safety has emerged through research and evaluation.

Defining exactly what is meant by alcohol regulation is complicated and at times ambiguous. Regulation is typically thought of as a government function. The federal government can establish excise taxes on alcohol that help control its price; state governments have alcohol beverage control agencies that make rules about who can sell alcohol; and local government can establish zoning ordinances that control the locations where alcohol may be sold. Regulation can also occur through nongovernmental policies. For example, a particular restaurant chain may establish its own policies about checking identification or refusing to serve drinks to people who appear to be intoxicated. Some regulatory policies may be informal or unwritten. Some policies that are formally established and written may be ignored or poorly enforced in practice.

The study of alcohol regulation is complicated by the many forms that it can take and the difference between the establishment of a regulation and its actual implementation and enforcement. The mechanisms by which alcohol regulation affects behavior and traffic safety are also complicated. Some regulations occur at the macro level. For example an increase in the federal excise tax on beer would affect millions of beer drinkers, but perhaps only slightly if the increase is small and represents a minimal proportion of the sale price (current federal tax only amounts to 2.5 cents per beer). Some regulations have effects that are much more localized: a change in zoning laws could mean that a neighborhood that previously had a bar on every corner now has fewer outlets. The appearance, function, and atmosphere of the neighborhood are now very different. There are fewer heavy drinkers driving to and from the neighborhood, possibly reducing traffic crashes. Some regulations affect individual decision making: a bartender has to decide whether to serve a patron another drink or cut him off before he is dangerously intoxicated.

The effects of regulation are also complicated by the fact that most drinkers have multiple sources for alcohol and can adjust their behavior as necessary to accommodate changes in price or availability. For example, if prices go up, drinkers can purchase cheaper beverages. Predicting the effects of any given regulatory change is difficult given the many different variables within the context of the environment that surrounds drinking.

One aspect of the regulation of alcohol sales that is particularly difficult to study is advertising practices. While advertising is frequently a source of concern, the effects of alcohol advertising on traffic safety have not been clearly demonstrated and effects on drinking in the general population are ambiguous. Certain types of advertising may cause responses in certain individuals, especially adolescents. These effects may not be measurable in the aggregate. Research has tended to be insensitive to more segmented effects and in many countries advertising is so pervasive that it is difficult to measure the effects of small changes.

Alcohol Price

One of the major regulatory strategies applied to alcohol is the regulation of price. Usually this occurs through the imposition of taxes, but it may also occur with respect to controls on special-price drink promotions (e.g., two drinks for the price of one during happy hour).

The study of the effects of price is complicated by the fact that taxes may be extremely small (e.g., the federal tax on beer amounts to about 2.5 cents per beer), thus a threshold may not have been reached to demonstrate the potential effects of pricing strategies. In addition, the price of alcoholic beverages at the retail level is influenced by many factors such as dealer markups. As noted above, individual drinkers may also respond to price increases by substituting different or less expensive beverages.

Despite these complications, research generally finds that increases in the price of alcohol reduce consumption. For example, a 10% increase in price would lead to a 5% to 12% decrease in consumption and a 6% reduction in alcohol-related traffic fatalities overall and a 9% decrease for teenage drivers.

These findings must be considered in light of a variety of methodological and analytic caveats. One possible confounding factor is that alcohol taxes, and thus alcohol prices, are often correlated with other alcohol policies and may reflect other attitudes and norms and characteristics of the culture that may also tend to reduce alcohol use and impaired driving.

Legal Framework for Alcohol Regulation in the United States

Laws related to alcohol regulation are established at all government levels in the United States and can sometimes be in conflict with one another. Typically, public health and safety are not priorities for laws at the federal level. Rather, federal laws are put in place to allow for tax collection and market stabilization. States, by contrast, are given the task of promoting health and temperance through their regulations of alcohol sales and service. State laws deal primarily with retail sales and establish the alcohol licensing and control systems.

In some states, alcohol regulation can also occur at the local level but there has been a trend towards state preemption laws. These laws limit the ability of local governments to establish regulations that are more restrictive than those imposed at the state level. Even in states that have preemption statutes, communities traditionally have authority to decide how the land is used—for example, whether a bar or liquor store can be licensed in a particular location.

Governments, whether federal, state, or local, face the task of balancing public health against other factors, e.g., economic concerns. Typically, regulators attempt not to put an undue burden on the alcohol industry. The federal government is taking an increasingly active role in disallowing state regulations that the government deems may interfere with interstate commerce.

Research on the effects of laws regarding alcohol regulation is complicated by the fact that even when laws are on the books, they may not be implemented or enforced.

Alcohol Regulation in the European Union

The establishment of the EU as a confederation of countries coordinating many aspects of law and policy has changed the alcohol regulatory environment in Europe. Countries with widely varying cultures and drinking styles now share many similar alcohol regulations. There has been a tendency for convergence among the member countries: those that previously had lenient alcohol- and impaired-driving policies have become stricter while those that previously were stricter have become more lenient.

The changes brought about in alcohol regulation have had a particular impact on the Scandinavian countries, especially Sweden, which had previously established extremely strict controls on the price and availability of alcohol. Prices have decreased and alcohol has been made more available. As a consequence, alcohol consumption in Sweden has increased over the last 10 years from 8 L per capita to 10.5 L. It has been estimated that a 2-L increase in consumption results in an 8% increase in traffic fatalities. Indeed, Sweden's previously very favorable trend in impaired-driving fatalities has dramatically reversed and alcohol now accounts for a much higher proportion of fatal crashes than before EU rules were adopted.

The problem of how to harmonize laws and policies in the EU without having a detrimental effect on health and safety in countries with previously more stringent laws has not been solved.

Alcohol Regulation in Latin America and the Caribbean

Currently, alcohol regulation is not widely utilized as a tool for promoting health and safety in most Latin American and Caribbean countries. For example, there are age restrictions in most countries but very little enforcement of these restrictions. Brazil does not have any sort of licensing system and does not restrict hours and days of sale—except that every 4 years, no alcohol can be sold on the day before elections. There are wide variations in prices and taxation and tax policies are not well enforced. Some countries have not established a blood alcohol content threshold above which it is illegal to drive.

Average alcohol consumption is much higher in Latin America than the global average. In addition, the patterns of consumption in Latin America tend to be riskier—with drinkers consuming large amounts per occasion rather than drinking small amounts more frequently. The quantity of consumption and the patterns of drinking contribute to a burden of disease resulting from alcohol, with impaired driving being an important component of that burden. The potential role of alcohol regulation in preventing alcohol problems has not yet been explored or exploited in most of these countries.

Minimum Purchase Age Laws

The establishment of 21 as the minimum purchase age for alcohol throughout the United States was extremely effective in reducing drinking among young people and in reducing impaired driving fatalities. It is estimated by the NHTSA that almost 1,000 lives are saved each year as a result of these laws. The traffic safety effects are presumably due to the fact that young people are inexperienced drivers and inexperienced drinkers and therefore are at an elevated risk for crashes should they drive after drinking even small amounts. The Centers for Disease Control and Prevention have carried out a systematic review of evaluations of age 21 laws and found a very strong effect. Questions remain about the exact role of the laws in reducing traffic crashes among young drivers. For example, there have been comparable declines in crashes among young people in Canada despite the fact that the drinking age in Canadian Provinces is lower than in the United States and has not changed.

Despite the apparent success of the higher minimum purchase age in the United States, there are periodic attempts to lower the drinking age. Sometimes these attempts are based on the misimpression that because young people still drink that the laws are ineffective. During the current war, the concern is sometimes raised that young people serving in the military can fight and die but not drink.

The minimum purchase age laws themselves can only be part of the regulatory strategy to reduce drinking by young people and consequent impaired driving. A complex of laws is needed that address underage drinking, including laws related to possession and consumption of alcohol by minors, furnishing or sales of alcohol to minors, the age of alcohol sellers, drivers license restrictions for young drivers, and so forth. No state currently has all of the laws considered optimal for restricting minors' alcohol access.

Enforcement is also a key element in the effectiveness of minimum purchase age laws in reducing underage drinking and traffic crashes among young drivers. An analysis of research on the impact of enhanced enforcement against sales to minors found that enforcement campaigns yielded reductions in sales and in underage alcohol consumption. Important variables that affected impact include enforcement intensity and media coverage. Effects tended to decay rapidly after the campaign was concluded.

Minimum Purchase Age Laws in New Zealand

In 1999, New Zealand changed its minimum purchase age laws, effectively lowering the purchase age to 18 from 20. This change occurred as other laws related to impaired driving were being made stricter and enforcement more vigorous. While the New Zealand government was tightening road safety countermeasures, alcohol was made significantly more available, including permitting the sale of wine at grocery stores and more liberal licensing laws. During the period between 1990 and 1995, the number of liquor licenses in the country almost doubled.

The 1999 reduction in the minimum purchase age occurred amid a falling overall road toll among 15- to 24-year-olds. The change in the law resulted in an increase in alcohol involved crashes among the affected age group, 18 and 19 year olds, over what would have occurred had the law not been changed. There was also an apparent trickle-down effect with crashes increasing for 15- to 17-year-old drivers. The findings in New Zealand mirror those in the United States in the 1970s when a number of states lowered their minimum purchase age.

The experience in New Zealand and United States can be viewed by other countries as an indication of the effectiveness of minimum purchase age laws and the potential deleterious effects of lowering the drinking age.

Limits on Outlet Density and Location

Research finds that the more alcohol outlets there are in a particular area, the more alcohol-related traffic crashes occur in the travel corridors that people use to drive to and from the outlets. It has been estimated that a 10% increase in the number of outlets can result in a 1% to 4% increase in alcohol-related crashes, with bars being the most consistently related to crash rates. In addition to impaired driving, areas with a high outlet density also experience more violent crime and underage drinking as well as other alcohol problems.

In general, the more convenient it is to obtain alcohol, the more people will drink and the more alcohol problems, including impaired-driving crashes, will occur. The location of alcohol outlets influences the ease of alcohol access. In addition, areas that have a large number of outlets in a small area can attract more drinkers and possibly problem drinkers as well as establish a community environment in which heavy alcohol consumption may seem normative. States and communities can use a variety of laws and regulations to control outlet location and density, including zoning ordinances and limits on liquor licenses within specified areas.

More research is needed to establish the mechanisms by which outlet location and density influence impaired driving and the most effective strategies for controlling locations and density in such a way as to improve traffic safety.

Limits on Hours of Sale

Limits on hours of sale of alcohol are imposed in most jurisdictions—both in stores that sell for off-premises consumption and in bars and other outlets with on-premises consumption. These limits are imposed in order to control consumption and problems. It has been hypothesized, however, that in on-premises establishments, when closing time approaches drinkers may drink more heavily and thus be even more intoxicated when they leave to drive home than if a strict closing time were not in place. Moreover, all of these intoxicated patrons are leaving bars at the same time. Many jurisdictions have expanded hours of service in order to reduce this hypothesized effect or in order to avoid the phenomenon of bar patrons traveling from one jurisdiction to another in order to take advantage of more liberal hours of service elsewhere.

Studies of the effects of limitations on hours of sale are limited and suffer from methodological weaknesses. For off-premises outlets, studies find some reductions in alcohol consumption and problems, including impaired driving, when hours and days of sale were restricted. For on-premises outlets, studies have mostly focused on jurisdictions in which drinking hours have been extended. Findings are complex but seem to indicate a trend towards increased drinking and impaired driving resulting from extended hours of drinking.

A study carried out on the U.S.–Mexico border examined the effects of the imposition of earlier closing times in the Mexican city of Juarez. The immediate effect was a dramatic drop in the number of Americans (mostly young people) who traveled to Mexico to drink. There was a gradual return to previous numbers but with drinkers returning home at earlier hours.

The research regarding hours of sale indicates that controls on times of sales and service can have a powerful effect on drinking and associated problems but that the effects are complex and a more detailed understanding is needed of how behavior is changed and how to avoid displacement of heavy drinking to different hours or locations with less restricted hours. The recent elimination of uniform closing times throughout Great Britain provides an opportunity to study the impact of expanding hours of service.

Dram Shop and Social Host Liability Laws

Most jurisdictions have laws prohibiting the sale or service of alcohol to intoxicated patrons or people under the minimum drinking age. These laws, especially those against sales to intoxicated persons, tend not to be enforced vigorously. In some states, however, people who have been harmed by a drinker who was served illegally can bring suit against the licensed establishment or the social host who served them. Analysis of states with such laws where major suits have been brought indicates that these suits have a deterrent effect on licensed establishments and can improve traffic safety. Comparable studies of social host liability have not been carried out.

Public nuisance laws present another type of legal option can also be used, especially against social hosts. These laws can establish a positive duty on the part of a homeowner to prevent parties where alcohol is served to minors or to intoxicated persons or that, because of noise or property damage, create a public nuisance. Homeowners who host or permit these parties must pay a fine and in some cases pay for the police response required by the party. This type of law has the potential for creating deterrence because the swiftness and certainty of consequences can be enhanced, as compared to criminal proceedings which tend to be slow and uncertain in their outcome. These statutes have recently been applied in college towns where landlords are given strong economic incentives to maintain order on their properties.

Both civil liability laws and public nuisance laws are promising as deterrents to risky drinking behavior. Law and policy makers, however, tend to gravitate towards criminal penalties because of the stronger message they appear to send—even though these laws are more difficult to enforce and to prosecute. Opposition to the most effective laws often comes, of course, from people with an economic interest in maintaining the status quo.

Responsible Beverage Service Practices

The regulation of how and to whom alcohol is served at bars and restaurants has the potential to have an important impact on traffic safety. Despite the fact that it is illegal to serve to intoxicated patrons, between one third and three quarters of intoxicated drivers stopped by police consumed their last drink at a bar.

The role of the server—bartender or waiter—has received considerable attention in attempting to prevent over service of alcohol. Servers in some localities or some establishments have been trained to recognize intoxication or monitor the number of drinks served. Research indicates, however, that expecting servers to make these judgments in many bar environments is not reasonable. Even trained law enforcement officers can detect high levels of intoxication only a minority of the time. In fact, research indicates that the servers have only a small role in determining whether patrons will leave an establishment in an intoxicated state. Managers create the environment and norms of establishments and set rules and monitor the behavior of servers and patrons. Some bars seem to be deliberately managed to serve as much alcohol as possible, regardless of the consequences to safety and health while others encourage moderation through their atmosphere and serving practices.

When laws are established mandating some level of responsible beverage service or server training, effects on alcohol levels of departing patrons and on traffic safety are sometimes observed. The effectiveness of the laws depends on several important components, including the program requirements, how the programs are administered, the level of enforcement, the types of penalties imposed, and the benefits to establishments that adhere to the laws.

Responsible beverage service practices are also sometimes applied to reduce sales of alcohol to minors. Effects of management policies and server or seller training are modest or mixed and enforcement seems to be more effective in preventing sales to minors.

In summary, the literature provides little support for the traffic safety effectiveness of broadly applied responsible beverage service training programs unless combined with significant enforcement. However, offering training may make intensive enforcement efforts more acceptable to communities and to enforcement agencies because communities may be reluctant to impose substantial penalties for law violations without first providing notice and help to establishments in meeting their obligations.

In recent years, some jurisdictions have adopted an aggressive program in which arrested impaired drivers are asked about their place of last drink. Establishments that are repeatedly reported are subject to warnings, intensive enforcement, and fines. These programs have been found to be cost effective and suggest that more targeted responsible beverage service programs combined with enforcement may have an impact on traffic safety.

Enforcement of Alcohol Regulation

While some alcohol regulations, such as alcohol taxes, can have an effect without major enforcement efforts, most depend on enforcement for their effectiveness. Enforcement of alcohol regulations can be carried out by different agencies, depending on the laws and regulatory and enforcement structures in the jurisdiction.

Law enforcement tasks depend on laws and structures in each state. All states have some sort of alcohol beverage control agency, which is responsible for licensing, and to varying extents, enforcement of the licensing requirements (such as adhering to hours of sale or service, not serving to minors, etc.). Increasingly, the budgets of these agencies and the available enforcement officers have declined, making it difficult for them to enforce laws vigorously throughout the hundreds and even thousands of retail outlets in the states. Moreover, especially in those states that have retained some part of the distribution under state control, the alcohol control agency must balance the economic benefits of liberal alcohol sales against the health and social benefits of tighter control.

Local law enforcement agencies also enforce alcohol regulations. It is often in their interest to do so because of the traffic risks and other crimes and problems associated with alcohol consumption. These agencies, however, are faced with enforcing highly unpopular laws and with balancing the many demands on their resources, including other problems that are considered more serious by the community.

Research on alcohol regulation indicates that vigorous and highly visible enforcement is important to the effectiveness of almost all regulatory strategies. Law enforcement leadership can benefit from information on effectiveness and cost effectiveness of enforcement and ways of carrying out enforcement most efficiently. This information can help make enforcement of alcohol regulations a higher priority and thus maximize the effectiveness of regulation.

Challenge of Alcohol Regulation

A variety of alcohol regulations can have an important impact on traffic safety as well as on other health and social problems. Enacting, implementing and enforcing regulations present many challenges—in crafting appropriate and acceptable regulatory strategies and in summoning the political and social will and resources needed.

In order to overcome these challenges the positive results of regulation must be balanced against the restrictions on behavior and commerce that they entail. Factors that can have an impact on the acceptability of such restrictions include the importance of the problem that the regulation is designed to address, the effectiveness of the regulation in preventing the problem, whether the regulation is minimally intrusive as compared to alternatives, and whether the behavior restricted has the potential to harm others besides the person engaging in the behavior. Research has begun to address these and other questions about alcohol regulations with respect to their impact on traffic safety.

An important characteristic of alcohol regulation that relates to overcoming inertia and political opposition is that it tends to have an effect on other health and social problems besides traffic safety. Thus, it is possible to form alliances with interest groups outside of traffic safety, including those concerned with crime and violence, risky sexual behavior, fetal alcohol effects, alcoholism, chronic disease related to alcohol use, and so forth. In particular, problems related to underage drinking can bring together broad coalitions of concern, including parents, schools,

youth service organizations, and others. Partnerships with a variety of advocacy organizations, citizen groups, and government agencies can be helpful in garnering the necessary support for bringing about implementation.

Overarching Issues

The regulation of alcohol sales and service has been shown to have effects on traffic safety as well as on other alcohol-related health and social problems. The effects of each type of regulatory strategy are controlled by mechanisms at the individual, local, state, and national level that are not fully understood. Some of the underlying mechanisms are related to dynamic processes related to the interaction of regulation and social norms, the non-linear impact of regulation, and the potential for reversals of progress. Each of these processes is described below.

Interaction of Regulation and Social Norms

The regulatory system and social norms are interrelated in complex ways. The strictness of regulation depends on societal norms and the norms are influenced by regulations. That is, governments at the federal, state, or local level are unlikely to implement regulations that are far out of sync with the social norms in the area. Once a regulation is implemented, however, social norms may begin to shift as certain behaviors are perceived as illegal and therefore unacceptable. When social norms have shifted, regulations can also become more stringent. This kind of iterative process has been observed in recent years as impaired driving has become more socially unacceptable and laws have become stricter and enforcement more vigorous. A particularly clear example of this kind of process is smoking. Smoking was once viewed as normative but is now much less socially acceptable and is regulated by stricter and stricter antismoking regulations.

Nonlinear Impact of Regulation

Another complexity in understanding the impact of alcohol regulation is that effects may not be linear. For example, a 1-cent price increase for beer might not have a measurable effect on behavior or on traffic safety. There may be a threshold that must be reached before effects can be observed. There may also be an upper limit beyond which the effects may deteriorate; when prices get too high, bootlegging, smuggling, and illicit manufacture of alcohol may become more common. Thus, the effects of any particular tax increase in any particular instance may not be easily generalizable to other amounts of increase in other settings. This same phenomenon may apply to other strategies; for example, there may be a minimum level of enforcement below which effects of a particular type of campaign may not be observed.

Potential for Reversals of Progress

It is important, in studying and planning alcohol regulation, to recognize that regulation is not necessarily a one-way process. Even very effective regulatory strategies can be eroded or reversed if proponents do not maintain their vigilance. For example, despite the proven effectiveness of the higher drinking age in the United States, there are always pressures to lower it again.

CONCLUSIONS

The complexity of the regulatory system and potential intended and unintended consequences presents challenges to researchers who want to understand the underlying processes. This complexity also poses challenges to regulators who want to have positive impacts without unwarranted restrictions or public backlash. The fact that the regulatory system is complex also means that there are many different potential points of intervention that can be utilized by policy makers and regulators at all levels. While the research on interventions is sometimes complicated, it is clear that regulatory strategies change drinking behavior and reduce alcohol related problems.

A well-regulated alcohol environment can change the way alcohol is perceived and consumed and ultimately improve traffic safety.

Alcohol Regulation and Traffic Safety

An Overview

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Broadly defined, alcohol policy includes (a) formal legal and regulatory mechanisms, rules, and procedures for controlling consumption of alcohol or risky drinking behaviors and (b) enforcement of these measures (Grube, 2005; Grube and Nygaard, 2001, 2005; Toomey and Wagenaar, 1999). Such policies can be implemented at the national, state, local, or institutional level. Alcohol policies can focus on restricting access or availability, deterrence, or harm reduction, although the distinction among these approaches is often blurred. A number of policy options seem to be effective in reducing drinking and driving and alcohol-related crashes and fatalities, including price, lower per se blood alcohol contents, random breath testing or sobriety checkpoints, graduated driver licensing, zero tolerance laws, and higher legal drinking ages. Social host liability and dram shop liability appear promising for reducing drinking and drinking-related problems. There is some empirical support for responsible beverage service programs, particularly those that are mandated or motivated by reduction of liability. The evidence is growing for the effects of outlet license restrictions (e.g., outlet density, hours of sale). Evidence that designated driver and safe rides programs are effective strategies for preventing drinking and driving is largely lacking. For many policy strategies there is simply not sufficient research to evaluate their effects. Such research should be conducted to inform policy or at least to evaluate policies as they are implemented.

Broadly defined, alcohol policy includes (a) formal legal and regulatory mechanisms, rules, and procedures for controlling consumption of alcohol or risky drinking behaviors and (b) enforcement of these measures (Grube, 2005; Grube and Nygaard, 2001, 2005; Toomey and Wagenaar, 1999). Overall alcohol policy has four goals: (a) to decrease availability of alcohol by increasing economic costs, including opportunity costs for obtaining it; (b) to directly deter or reduce consumption, heavy consumption, or drinking-related problem behaviors by increasing the potential personal or social costs associated with these behaviors; (c) to decrease relative costs of alternative behaviors; and (d) to decrease demand. The overall goal of alcohol policy is to increase full costs of drinking or involvement in drinking-related problem behaviors. Full costs include price, but also the effort and time needed to obtain alcohol and the personal risks for engaging in problem behaviors such as drinking and driving (e.g., risk of injury or sanctions). Alcohol policies can also increase the relative costs of drinking or drinking and driving by reducing the costs associated with alternative behaviors such as using public transportation.

Alcohol policy can be implemented at the national, state, local, or institutional level. Although alcohol control is primarily a state responsibility under the 21st Amendment to the U.S. Constitution, many states allow counties and municipalities to take steps to control drinking that are more restrictive than those required by state law. Communities, for example, can implement zoning restrictions (e.g., regulate outlet densities, distances from schools); require responsible beverage service training; institute social host ordinances; or take other policy or enforcement actions (e.g., proactive party dispersal) as long as these activities are not less

restrictive than state law. Importantly, alcohol policies are not limited to formal laws. Rather they can include institutional responses such as responsible beverage service policies in bars, changes in social environments (e.g., media), levels of enforcement and enforcement priorities, and local planning and zoning.

ALCOHOL POLICY AND THE PREVENTION PARADOX

Many alcohol policy approaches target populations, rather than individuals, and explicitly recognize that alcohol problems do not originate only with heavy drinkers or problem drinkers. Rather, social drinkers and light drinkers also contribute, although their individual risks are lower. This apparent contradiction between individual and population risk levels is called the prevention paradox (Kreitman, 1986; Skog, 1999). According to the prevention paradox, lighter drinkers may, in fact contribute more problems at the population level because of their greater numbers in the population. Thus, for example, data from the Swedish conscript study indicate that the highest 10% heavy drinkers account for only 22% of hospital admissions for attempted suicide and 26% of admissions for injuries from violence (Rossow and Romelsjö, 2006). Even if all admissions for suicide attempts and injuries among heavier drinkers are assumed to be alcohol related, these drinkers account for less than half of these outcomes. In a Finnish study, 30% of all self-reported problems, 30% of alcohol-related hospitalizations, 36% of alcohol-related deaths, and 36% of the premature life years lost before the age of 65 occurred among the 10% of heaviest drinkers. In the area of traffic safety, the vast majority of alcohol-related crashes occur among drivers who are in the intermediate risk ranges in terms of blood alcohol content (BAC) or previous arrest (Woodall et al., 2004). A recent study of college students (Weitzman and Nelson, 2004) showed that there was an increasing individual risk of injury as usual quantity of drinking increased. Thus, about 25% of those who usually consumed five or more drinks per occasion reported sustaining an alcohol-involved injury sometime during the school year compared with about 19% of those who usually consumed fewer drinks. Extrapolating from the data, however, indicates that those typically consuming fewer than five drinks, because of their greater numbers in the population, accounted for 62% of the reported alcohol-related injuries overall whereas those typically consuming five or more drinks accounted for 38% of them. It has been suggested that heavy episodic drinking by those whose usual alcohol consumption is low or moderate may account for the prevention paradox (Stockwell et al., 1996). Nonetheless, the prevention paradox suggests that policies targeting only heavier or problem drinkers may not be entirely effective at reducing problems, including traffic crashes and fatalities. Rather, policies may be more effective when they target populations as a whole, particularly focusing on heavy drinking episodes.

TYPES OF ALCOHOL POLICY

Availability Policies

Alcohol availability theory proposes that alcohol consumption and problems increase as ease of obtaining alcohol increases and costs decrease. Based on the distribution of consumption model, availability approaches assume that restricting access to alcohol will decrease consumption in the

overall population and, and as a result, will lead to reductions in alcohol-related problems, including traffic safety problems (Rush and Gliksman, 1986). Alcohol availability refers to three interrelated constructs: physical availability, social availability, and economic availability. Physical availability refers ease of access to alcohol through commercial alcohol sources. Physical availability is often indexed as the density of or an individual's proximity to commercial outlets and drinking venues in the environment. Social availability refers the ease of obtaining alcohol through social sources (friends, acquaintances, or strangers) and to social support for drinking in the environment. It thus includes both social accesses to alcohol and to community and individual norms regarding drinking in general and in specific contexts. The normative component of social availability comprises a wide range of environmental factors including consumption by others within a given community, expressed attitudes by others, frequency and natures of alcohol advertising and portrayals in the media, as well as policies that encourage or discourage drinking. Economic availability refers to the cost of alcohol relative to other products and to access to the resources necessary to buy or otherwise obtain alcohol.

Many alcohol policies attempt to decrease availability of alcohol by increasing relative costs, including opportunity costs, associated with obtaining it. Examples of availability policies include increases in price (taxation, prohibitions on drink specials), restrictions on conditions of sale (e.g., hours, locations), and social host ordinances that impose penalties or liability on private party hosts who provide alcohol for underage youth or serve intoxicated guests. Importantly, the components of availability are interdependent and policies affecting one type of availability may have consequences for others. Price, for example, may influence overall drinking rates in a community and, therefore, social availability. Consumption rates in a community, in turn, may affect physical availability through increased outlet density because of increased demand and market forces. Increased density, in turn, may decrease prices through increased competition.

Deterrence Policies

The purpose of deterrence policies is to increase the personal consequences or anticipated consequences of alcohol consumption or consumption in risky contexts by imposing penalties or sanctions. According to deterrence theory, the effectiveness of such penalties is affected by their severity, the probability of their imposition, and the swiftness with which they are imposed (Ross, 1984). The severity of consequences is largely governed by the nature of the policies themselves and the penalties they inflict. Certainty and swiftness of imposition result from levels of enforcement and adjudication. Examples of deterrence policies include fines or other penalties for drinking and driving and loss of driver license for minors in possession of alcohol (e.g., zero tolerance).

Many policies have both availability and deterrence properties. For example, minimum drinking age laws make it more difficult for young people to buy alcohol and also include penalties for possession or consumption of alcohol by those who are underage. Compliance checks by local police may threaten local retailers with fines or license revocation and, consequently, increase the difficulties experienced by youth or intoxicated patrons who attempt to purchase alcohol. Similarly, social host liability ordinances that impose penalties for private party hosts who provide alcohol for underage youth, controlled party dispersal operations by local police or Alcoholic Beverage Control agents, and local ordinances that restrict alcohol use in public places can increase direct consequences to youth, reduce youth access to alcohol from

social sources, and reinforce community norms against youth drinking or providing alcohol to youth.

Harm Reduction Policies

Harm reduction policies seek to prevent risky drinking or moderate the relation between consumption and problems without necessarily affecting overall consumption (Incardi and Harrison, 2000). Although most harm reduction approaches are individually oriented and focus on controlled drinking or moderation (Marlatt and Witkiewitz, 2002; Neighbors et al., 2006), some policies can be thought of as promoting harm reduction. Responsible beverage service interventions for bars and restaurants, for example, focus on training servers and on developing outlet policies designed to reduce over service and prevent intoxication, not consumption per se. Ignition interlock programs seek to prevent intoxicated individuals from driving, but may not directly decrease drinking. Safe rides programs and increased public transportation do not address consumption or heavy drinking, but rather seek to reduce the traffic safety risk (problems) associated with consumption by making alternatives to drinking and driving easier. Similarly, primary safety belt laws do not address alcohol use at all, but may reduce alcohol-related fatalities.

EFFECTIVENESS OF SELECTED POLICY APPROACHES

Restrictions on Availability

Availability policies are intended to affect alcohol consumption and problems by increasing the economic and opportunity costs of drinking.

Minimum Legal Drinking Age

Perhaps the most dramatic illustration of the potential effects of reducing physical availability of alcohol on traffic safety is the minimum legal drinking age (MLDA). In 1984, the National Minimum Drinking Age Act required states to enact a minimum age of 21 years for purchase or public possession of alcohol or risk losing federal highway funds. Since 1987, the MLDA in the United States has been 21 years in all 50 states and the District of Columbia. The available studies show that increasing the MLDA significantly decreased drinking, drinking and driving, and drinking and driving crashes among young people (Dee, 1999; Klepp et al., 1996; O'Malley and Wagenaar, 1991). Overall, it has been estimated that the MLDA of 21 has saved 24,560 lives between 1975 and 2005 through reducing traffic fatalities alone (NHTSA, 2006).

Despite the uniform MLDA of 21, underage youth are able to obtain alcohol from both commercial and social sources (e.g., Dent, Grube, and Biglan, 2005; Paschall et al., in press-a,b; Wagenaar et al., 1996). Purchase surveys, for example, show that anywhere from 40% to 90% of outlets may sell to underage buyers (e.g., Forster et al., 1994, 1995; Paschall et al., in press; Preusser and Williams, 1992; Grube, 1997). In part, these high sales rates result from low and inconsistent levels of enforcement of sales laws (Wagenaar and Wolfson, 1995). Importantly, however, research shows that even moderate increases in enforcement of sales laws can reduce sales of alcohol to minors by as much as 35% to 40%, (Grube, 1997; Wagenaar et al., 2000). Such enforcement may also reduce alcohol consumption and problems among youth (Barry et

al., 2004). Simple warning letters to vendors about enforcement activities or visits by police to outlets appear to have little effect (Willner et al., 2000).

Conditions of Sale

Zoning ordinances, conditional use permits, and other local ordinances are often used to limit availability by controlling outlet densities, opening hours, and other conditions of alcohol sales. There is evidence that local restrictions on outlet density are related alcohol consumption and problems (Gorman, Labouvie, and Subaiya, 1998; Gorman, Labouvie, Speer, and Subaiya, 1998; Gruenewald et al., 1993, 2002), including drinking and driving (Gruenewald, Johnson, and Treno, 2002; Gruenewald et al., 1996). In one of the few studies focusing on youth (Treno, Grube, and Martin, 2003), outlet density was found to be positively related to frequency of underage driving after drinking and riding with drinking drivers among 16- to 20-year-old youth.

Hours of Sale

Although the findings are mixed, restrictions on hours of sale may also be important. In a recent study in Perth, Australia, extended hours for bars were found to be related to an increase in assaults (Chikritzhs and Stockwell, 2002) and traffic crashes (Chikritzhs and Stockwell, 2006). These relationships were largely accounted for by increased sales of high alcohol content beer, wine, and spirits. Similarly, a new city policy prohibiting on-premises alcohol sales after 11 p.m. in Diadema, Brazil, was found to be related to a significant decrease in homicides (Duailibi et al., in press). Prior to the new policy, hours of sale had been unregulated. In contrast, a survey study of temporarily extended sales hours in Fremantle, Australia, did not find an increase in overall alcohol consumption, although survey respondents who more often availed themselves of the extended hours consumed greater amounts of alcohol (McLaughlin and Harrison-Stewart, 1992). Recent studies have investigated the effects of extending drinking hours from 1 to 2 a.m. in Ontario, Canada. A significant increase in alcohol-related motor vehicle fatalities was found in the Windsor, Ontario, area and decreases in the neighboring Detroit area (Vingilis et al., 2006). No effects, however, were found for the province as a whole (Vingilis et al., 2005). Extending hours to allow Saturday sales in Sweden (Norstrom and Skog, 2003, 2005) has been associated with a significant increase in alcohol sales (3.3%) and drinking and driving (8.3%) on Saturdays and Sundays. It is unclear, however, to what extent the increase in drinking and driving resulted from liberalized hours of sale or from changes in police enforcement. More convincing evidence that substantial extensions in hours of sale can affect traffic safety is provided by a study in New Mexico that found a 29% increase in alcohol-related crashes and a 42% increase in alcohol-related crash fatalities on Sundays after sales of packaged alcohol were allowed on that day (McMillan and Lapham, 2006).

Privatization

In some jurisdictions the retail sale or wholesale distribution of alcohol is controlled through state-run monopolies. In recent years there has been a trend toward privatization, especially of retail sales (Shaffer and Brenner, 2004; Ziegler, 2006). Privatization is hypothesized to increase alcohol consumption and related problems by increasing availability (e.g., making it easier to obtain alcohol) and by reducing prices through increased competition (Holder et al., 1995). Some

studies find an increase in consumption following privatization (Holder and Wagenaar, 1990; Trolldal, 2005a; Wagenaar and Holder 1995) and substantial increases in consumption and mortality have been projected as a result of privatization in the Nordic countries (Andreasson et al., 2006; Holder et al., 1995). However, other studies have provided more mixed findings. In a study of Alberta, Canada, for example, privatization had a significant permanent effect on the sale of spirits, but not on wine, beer, or total sales (Trolldal, 2005b). There was no effect in this study on fatal motor vehicle traffic crashes.

Price and Taxation

Numerous studies have focused on the relation between taxation or price and alcohol consumption and related problems. It has been estimated that increasing taxation on alcohol in the United States to keep pace with inflation would lead to a 19% reduction in heavy drinking by youth and a 6% reduction in high-risk drinking (Laixuthai and Chaloupka, 1993). Substantial reductions in drinking and driving and alcohol-related traffic fatalities have been associated with price or tax increases (Saffer and Grossman, 1987a). It has been estimated that increasing the price of beer to keep pace with inflation would reduce youth drinking by 9% and heavy drinking by 20% (Laixuthal and Chaloupka, 1993). In contrast to these studies, however, recent research have found no evidence for the effects of taxation and price on alcohol consumption and alcohol-related traffic fatalities, either among youth or in the general population (Dee, 1999; Young and Likens, 2000). Although taxation and price increases may be effective prevention strategies in some cases, price elasticities are not attributes of commodities and are moderated by social, environmental, and economic factors. As a result, the price sensitivity of alcohol may vary considerably across time, states, and countries, depending on drinking patterns and attitudes and on the presence of other alcohol policies. More recent studies, for example, suggest that the relations between taxes on alcohol and alcohol consumption and problems may have weakened in recent years in the United States, possibly because of the implementation of the age 21 MLDA and other alcohol policies (Young and Likens, 2000). It recently has been suggested that people respond primarily to changes in the full price of alcohol, including opportunity costs (Trolldal and Ponicki, 2005). As a result, the demand for alcohol should be less sensitive to changes in price where regulation is stricter. Consistent with this hypothesis, it was found that demand for beer and spirits was less price sensitive in states with monopolies on alcohol sales and distribution than in license states where alcohol sales are privatized. Similarly, a recent study showed that raising either MLDA or beer taxes in isolation led to fewer youth traffic fatalities (Ponicki, Gruenewald, and LaScalla, in press). A given change in price, however, caused a larger proportional change in fatalities when the MLDA was low than when it was high. Thus, a 10% increase in price was estimated to reduce traffic fatalities among youth by 3.1% if the legal drinking age were 18, but only by 1.9% if the legal drinking age were 21. It was concluded that communities with relatively strong existing policies might expect smaller impacts on alcohol-related problems to result from the implementation of new policies than suggested by prior research, whereas communities with weak policies might expect larger benefits.

Drink Promotions

Drink promotions are a specific marketing strategy that offers alcoholic beverages at reduced prices (e.g., two for the price of one, ladies drink free, or half-price six packs). Because drink

promotions can substantially reduce the economic costs of drinking to the consumer, it is possible that they have a greater effect on drinking than taxation or more indirect strategies for increasing price. Although there is little research on the effects of drink promotions, a recent national study of colleges indicates that drink promotions are common in bars and other outlets around campuses (Kuo, Wechsler, Greenberg, and Lee, 2003). Moreover, sales prices, and frequent promotions at both on- and off-premise establishments were associated with higher rates of heavy episodic drinking. Similarly, availability of lower prices and set fees (i.e., unlimited drinks for a fixed price) has been associated with greater consumption among college students (Wechsler, Kuo, Leem, and Dowdall, 2000). Although far from definitive, this research suggests that limiting drink promotions may reduce consumption and concomitant problems.

Deterrence Policies

Deterrence policies apply sanctions to discourage drinking or risky drinking behaviors (e.g., drinking and driving), providing alcohol to minors, or over service.

Blood Alcohol Limits

There is strong evidence that reducing the legal per se blood alcohol limit that defines driving while impaired decreases drinking and driving and alcohol-related crashes. Thus, it has been estimated that reducing blood alcohol limits from 0.10% to 0.08% in the United States led to a 6% decrease in the proportion of drivers in fatal crashes with blood alcohol levels at 0.10% or higher and a 5% greater decrease in the proportion of fatal crashes that were alcohol related at 0.10% or higher (Hingson, Heeren, and Winter, 2000). Similarly, introduction of Ontario, Canada's, 0.08% per se legislation in 1969 has been associated with an estimated reduction of 18% in the number of fatally injured drinking drivers (Asbridge et al., 2004). A time series study of traffic deaths in the United States between 1980 and 1997 indicated about a 14% lower rate of alcohol-related motor vehicle mortality and a 13% lower rate of motorcycle mortality when laws specifying a legal BAC of 0.08% were in effect (Villaveces et al., 2003). A recent review suggests that overall, lowering the legal BAC from 0.10% to 0.08% in the United States was related to an overall 5.2% reduction in single-vehicle nighttime fatal traffic crashes, after adjusting for administrative license revocation, the number of Friday and Saturday nights in a month, and trends in all other types of fatal traffic crashes (Bernat, Dunsmuir, and Wagenaar, 2004). This effect did not differ by jurisdiction or baseline rates of driving under the influence (DUI). Importantly, reduced legal blood alcohol levels appear to affect heavy drinkers and repeat offender DUI drivers as well as those with no prior convictions. Thus, an evaluation of reducing the legal BAC from 0.10% to 0.05% in Maine indicated that the proportion of fatal crashes involving drivers with recorded prior driving-while-intoxicated convictions declined 25%, while the proportion of such cases rose in the rest of New England during the same years (Hingson, Heeren, and Winter, 1998). In contrast to these studies, there is some evidence that lowering BAC levels may not always be effective. Thus, a recent study indicates that introducing a 0.08% legal BAC limit in Texas did not significantly reduce either alcohol-involved crashes or alcohol-involved fatal crashes (Gorman, Huber, and Carozza, 2006). The authors suggest that research should move toward understanding the circumstances under which per se BAC laws contribute to a decline in alcohol-involved accidents and fatalities. As with prices, it is likely that the effects of many deterrence policies are conditional upon a number of factors, including what other

policies are in place. In terms of BAC limits, levels of enforcement are undoubtedly another important factor.

Zero Tolerance

Zero tolerance laws are a special case of per se laws that apply lower legal BACs to drivers under the legal drinking age. These limits are generally set at the lowest level that can be reliably detected. Zero tolerance laws have been found to be very effective in reducing underage drinking and related problems. In one study zero tolerance laws were associated with a 19% reduction in self-reported driving after any drinking and a 24% reduction in reported driving after five or more drinks using Monitoring the Future survey data from 30 states across the United States (Wagenaar, O'Malley, and LaFond, 2001). Similarly, it has been estimated that the implementation of zero tolerance laws in the United States reduced alcohol-related fatal crashes among young drivers by as much as 24% (Voas et al., 2003). Stricter zero tolerance provisions may be related to the greater effectiveness of the law. Thus, an early study (Hingson, Heeren, and Winter, 1994) found a 22% reduction in single-vehicle nighttime fatalities among underage drivers in states implementing a 0% BAC for young drivers, a 17% reduction in states with a 0.02% allowable BAC, and a 7% reduction in states with 0.04% to 0.06% allowable BACs. Effective enforcement and awareness of the laws among young people also have been identified as key factors in the success of zero tolerance laws (Ferguson, Fields, and Voas, 2000; Hingson, Heeren, and Winter, 1994; Voas, Lange, and Tippetts, 1998). Impediments to the enforcement of these laws include (a) requiring that zero tolerance citations be supported by evidential BAC testing, (b) undue costs to police (e.g., paperwork, time, court appearances), and (c) lack of behavioral cues for stopping young drivers at very low BACs. It has been suggested that the most effective zero tolerance laws include passive breath testing, are implemented in combination with DUI checkpoints or random breath testing (RBT), and involve streamlined administrative procedures (Ferguson, Fields, and Voas, 2000). Using media to increase young peoples' awareness of reduced BAC limits and of enforcement efforts may also increase the effectiveness of zero tolerance laws.

Loss of Driving Privileges

Many policies attempt to reduce drinking and driving through the threat of loss of driving privileges. Such policies include administrative driver license repeal and vehicle impoundment. In a recent evaluation of a broad driver improvement program that included warning letters, group meetings, individual hearings, and license suspension or revocation, small overall effects were found on crashes and violations (Masten and Peck, 2004). Driver license suspension or revocation was by far the most effective intervention for both crashes and violations. The authors note, however, that one of the objectives of license suspension or revocation is to eliminate driving for the period of suspension. It is thus possible that much or all of the effect of this intervention due to reduced exposure and/or more careful driving during the suspension interval. A recent study of administrative drivers' license suspension in Ontario, Canada, found the policy was associated with an estimated 17.3% decrease in fatally injured drivers who were over the legal limit (Mann et al., 2002). In another study the incidence of alcohol-related mortality in motor vehicle crashes and overall motorcycle mortality were each found to be about 5% lower when administrative license revocation laws are in effect (Villaveces et al., 2003).

Sobriety Checkpoints

In sobriety checkpoints drivers are stopped and interviewed by police. If there is probable cause, a breath test is administered. There is evidence that sobriety checkpoints reduce drinking and driving and related traffic crashes. An evaluation of a one checkpoint program (Lacey, Jones, and Smith, 1999) found a 20% decrease in alcohol-related fatal crashes and a 6% reduction in single-vehicle nighttime crashes that were sustained up to 21 months after implementation of the program. In another study, the proportion of drivers with BACs over 0.05% was reduced by 70% (Lacey et al., 2006). Police may miss a substantial proportion of drinking and even intoxicated drivers in sobriety checkpoints (Wells et al., 1997). Nonetheless, a review of American and Australian studies (Peek-Asa, 1999) concludes that the available evidence consistently indicates that both RBT and sobriety checkpoints reduce alcohol-related crashes, injuries, and fatalities.

Dram Shop Liability

Dram shop liability laws allow individuals injured by a minor who had been drinking or by an intoxicated adult to recover damages from the alcohol retailer who served or sold alcohol to the person causing the injury. Owners and licensees can be held liable for their employees' actions under most or all dram shop liability laws. Overall, dram shop liability has been estimated to reduce alcohol-related traffic fatalities among underage drivers by 3% to 4% (Chaloupka, Saffer, and Grossman, 1993). Another study using national survey data found that dram shop liability laws reduced self-reported incidents of drunk driving among all drinkers, but not the probability of heavy episodic drinking or drinking and driving among heavy drinkers (Stout et al., 2000). Another study concluded that dram shop liability laws have negative and statistically significant effects mortality rates from traffic crashes and also for other causes of mortality (Sloan et al., 1994). Nonetheless, further research on dram shop liability laws is necessary.

Social Host Liability

Under social host liability laws, adults who serve alcohol to a minor or an intoxicated adult in a noncommercial setting can be sued through civil action for damages or injury caused by that person. Social host liability laws may deter adults from hosting underage parties, purchasing alcohol for or providing alcohol to minors, and over serving. There is very little research on the effectiveness of social host liability laws. In one study, the presence of social host liability laws was associated with decreases in alcohol-related traffic fatalities among adults, but was unrelated to such deaths among minors (Whetten-Goldstein et al., 2000). In a second study using self-reported drinking data, social host liability laws were associated with decreases in self-reported heavy drinking and drinking and driving (Stout et al., 2000).

Enforcement

Enforcement is a key element in the effectiveness of deterrent policies to prevent alcohol-related harm. In particular, the such policies are influenced by their severity, the probability of their imposition, and the swiftness with which they are imposed (Ross, 1984). Although severe, penalties for many alcohol offenses are often not enforced and thus can be expected to generate only a modest deterrent effect (cf., Hafemeister and Jackson, 2004). Thus, a report by Voas,

Lange, and Tippetts (1998) on the enforcement of the zero tolerance law in California, for example, found only a small increase in enforcement intensity and no change among the target group members in the perceived risk of arrest. The study also found no reduction in involvement of young drinking drivers in fatal crashes. Although zero tolerance laws are implemented at the state level, enforcement is largely a matter of local policy and falls to local police and sheriffs through traffic control and related activities. Differences in local enforcement of zero tolerance laws have been identified as a key issue in understanding why some programs are less successful than others (Ferguson, Fields, and Voas, 2000). In general, policies that increase the likelihood of apprehension may be more effective than those that simply impose more severe penalties (Hafemeister and Jackson, 2004; Sloan et al., 1994). Thus, for example, there is evidence that simply increasing or mandating jail sentences for drinking-and-driving-related offenses does not reduce recidivism or decrease the incidence of drinking and driving (Grube and Kearney, 1983; Martin, Annan, and Forst, 1993).

Harm Reduction Policies

Responsible Beverage Service and Sales

Research indicates that servers of alcohol rarely intervene to prevent intoxication or refuse service to intoxicated patrons. Studies show that pseudointoxicated patrons (actors feigning drunkenness) can buy alcohol in bars, restaurants, and off-premise outlets as much as 50% to 60% of the time (Donnelly and Briscoe, 2003; Lenk, Toomey, and Erickson, 2006; Toomey et al., 1999, 2004). Similarly, alcohol purchase surveys show that anywhere from 40% to 90% of outlets sell to underage buyers, depending upon location (Forster et al., 1994, 1995; Preusser and Williams, 1992; Grube, 1997). Responsible beverage service and sales (RBS) consists of the implementation of a combination of outlet policies (e.g., requiring clerks or servers to check identification for all customers appearing to be under the age of 30 years; requiring all servers to be over 21 years of age), manager training (e.g., policy development and enforcement), and server training (e.g., teaching clerks and servers to recognize altered or false identification and to monitor numbers of drinks served). The purpose of these interventions is to reduce sales to minors, sales to intoxicated patrons, and over service. RBS can be implemented at both on-license and off-license establishments.

Overall, the evidence for the effectiveness of RBS programs is mixed and inconclusive (Ker and Chinnock, 2006). Thus, in several studies RBS has been found to reduce the number of intoxicated patrons leaving a bar (Dresser and Gliksman, 1998; Gliksman et al., 1993; Saltz, 1987, 1989) and reduce car crashes (Holder and Wagenaar, 1994). Other studies, however, have been less successful in demonstrating effects of server training on service to seemingly intoxicated patrons, car crashes, numbers of bar patrons with BACs over 0.15%, or checking of identification (Lang et al., 1998; Saltz and Stanghetta, 1997). Few studies have evaluated the effects of RBS programs on underage sales. In one study of off-license RBS, voluntary clerk and manager training were found to have a negligible effect on sales to minors above and beyond the effects of increased enforcement (Grube, 1997). Similarly, a study in Australia found that, even after training, age identification was rarely checked in bars, although decreases in the number of intoxicated patrons were observed (Lang, Stockwell, Rydon, and Beel, 1996, 1998). In one study, RBS training was associated with an increase in self-reported checking of identification by servers (Buka and Birdthistle, 1999). The self-reported changes in behavior persisted among

trained servers for as long as 4 years. Another study reported an 11.5% decrease in sales to minors and a 46% decrease in sales to intoxicated patrons following individual manager training and policy development (Toomey et al., 2001). Voluntary programs may be less effective than mandatory programs or programs using incentives such as reduced liability (Dresser and Glikzman, 1998).

The inconsistency among evaluations of RBS may be due to differences in program content and implementation. Policy development and implementation within outlets may be as important, if not more so, than server training per se in determining RBS effectiveness (Saltz, 1997). Research indicates, for example, that establishments with firm and clear policies and a system for monitoring staff compliance are less likely to sell alcohol to minors (Wolfson, Toomey, Forster et al., 1996; Wolfson, Toomey, and Murray, 1996). In addition to problems in implementing RBS, evaluation of the general effectiveness of RBS is difficult because of the great variation in the quality and focus of available programs (Toomey et al., 1998). In particular, programs differ in the extent to which they include managers and owners, as well as staff, and emphasize policy development and implementation.

Safe Rides and Designated Driver Programs

Safe ride and designated driver programs provide drinkers with an alternative means of transportation (e.g., taxi vouchers, free transportation, special buses) or encourage drinking groups to name a designated driver who refrains from drinking. Safe ride and designated driver programs are increasingly popular in community and college settings. Such programs are sometimes implemented by bars and restaurants as an adjunct to RBS programs. Although designated driver programs are often strongly promoted, there is little available evidence of their effectiveness. Survey studies suggest that substantial numbers of drinkers and heavy drinkers report using such programs to avoid driving themselves (Caudill, Harding, and Moore, 2000; Sarkar, Andreas, and de Faria, 2005), although other studies suggest that very few drinkers (<7%) actually avail themselves of such programs (Simons-Morton and Cummings, 1997). Unfortunately, some data indicate that people do not have a good idea of what constitutes a safe designated driver. They report that the designated driver is often the person in their group who had consumed the least alcohol, even though that may have been a significant amount (Nygard et al., 2003). Designated drivers themselves report drinking substantial amounts when serving in that role (Stevenson et al., 2001). Encouragingly, a recent study suggests that a brief intervention with designated drivers can reduce their consumption (Lange, Reed, Johnson, and Voas, 2006). There is little or no evidence regarding the effectiveness of safe ride or designated driver programs in reducing drinking and driving or alcohol-related crashes.

Ignition Interlocks

Ignition interlock devices are intended to reduce recidivism among convicted drunk drivers. When an interlock is in place on a vehicle, a driver must provide a breath sample prior to driving. If the breath alcohol concentration exceeds a predetermined level (usually 0.02% to 0.04%), the vehicle will not start. It appears that interlock programs can substantially reduce recidivism. In a study of convicted DUI drivers from New Mexico, for example, it was found that 2.5% of drivers with interlocks were rearrested for a DUI offense compared with 8.1% of those without interlocks (Roth, Voas, and Marques, 2007). Similar results have been reported in other studies

(Bjerre, 2005; Raub, Lucke, and Wark, 2003; Voas, Marques, Tippetts, and Beirness, 1999). A recent Cochrane review (Willis, Lybrand, and Bellamy, 2004) concluded that the evidence for the effectiveness of interlocks suggests that they can reduce recidivism among first time and repeat drunk drivers, but there was little evidence that participating in an interlock program reduced recidivism once the interlock is removed from the vehicle. It was noted, however, that few randomized trials have been conducted and that selection bias may confound the results of many of available studies. In particular, it is possible that lower risk drivers are assigned to interlock programs by courts to or are more likely volunteer to participate in such programs, thus making them appear more effective. Other studies have noted that only a small fraction of those eligible or even mandated for interlock programs actually install an interlock on their vehicles (Bjerre, 2005; DeYoung, 2002; Voas, Marques, Tippetts, and Beirness, 1999). Importantly, interlock programs appear to be as effective for mandated participants as for voluntary participants (Beirness, Marques, Voas, and Tippetts, 2003). In one of the few randomized trials, an interlock program reduced the risk of committing an alcohol traffic violation within the first year by 65% (Beck, Rauch, Baker, and Williams, 1999). There was no difference between the interlock and noninterlock groups, however, after the interlock was removed.

Graduated Driver Licensing

Graduated driver licensing (GDL) laws place restrictions on the circumstances under which young or novice drivers are allowed to drive, such as prohibiting driving during certain hours or driving with other young people in the vehicle. Some GDL laws contain zero tolerance provisions regarding alcohol. Studies of GDL routinely show that it is associated with reductions in drinking, motor vehicle crashes, alcohol-related crashes, and other injuries among young people (Begg et al., 2001, 2003; Chen, Baker, and Li, 2006; Margolis, Masten, and Foss, 2007; Shope and Molnar, 2003). A recent Cochrane review of GDL programs in four countries (United States, Canada, Australia, and New Zealand) indicated that these programs were associated with an overall 31% reduction in crash rates, although there was considerable variation among studies (Hartling et al., 2004). It appears that the effects of GDL do not extend beyond the period of directly affected by driving restrictions (Mayhew, Simpson, Desmond, and Williams, 2003) and that the effects of GDL may be largely due to driving restrictions (e.g., no nighttime driving), rather than to increases in the instructional permit period (Masten and Hagge, 2004). GDL also may be an important adjunct to zero tolerance laws. For example, GDL violations might provide cause for stopping young drivers at night that may be drinking at very low levels that otherwise would not be detected.

SUMMARY

Broadly defined, alcohol policy includes (a) formal legal and regulatory mechanisms, rules, and procedures for controlling consumption of alcohol or risky drinking behaviors and (b) enforcement of these measures (Grube, 2005; Grube and Nygaard, 2001, 2005; Toomey and Wagenaar, 1999). Such policies can be implemented at the national, state, local or institutional level. Alcohol policies, generally, can be thought of focusing on restricting availability, deterring drinking or risky drinking behaviors, or on harm reduction. The distinctions among these policy

approaches, however, are often unclear. Many policies, for example, may include aspects of each of these approaches.

A number of policy options seem to be effective in reducing drinking and driving and alcohol-related crashes and fatalities, including price, lower per se BACs, RBT or sobriety checkpoints, GDL, zero tolerance laws, and higher legal drinking ages. Social host liability, and dram shop liability appear promising for reducing drinking and drinking-related problems. There is some empirical support for responsible beverage service programs, particularly those that are mandated or motivated by reduction of liability. The evidence is growing for the effects of outlet license restrictions (e.g., outlet density, hours of sale). Evidence that designated driver and safe rides programs are effective strategies for preventing drinking and driving is largely lacking. For many policy strategies there is simply not sufficient research to evaluate their effects. Such research should be conducted to inform policy or at least to evaluate policies as they are implemented.

It is also apparent that the effects of alcohol policies are complicated and interdependent. In particular, the incremental effect of any given policy in a given context is likely dependent upon a complex array of factors, including what other policies are in place. Thus, price may have a smaller effect on underage drinking and driving in the presence of strictly enforced and more restrictive MLDA and zero tolerance laws. This interdependence of policy may explain differences among studies in terms of the size of the effects that are found when a specific policy is implemented. It also makes it difficult to estimate in advance the effects of any given policy in a given context.

Most policies are ineffective unless they are adequately implemented there is awareness of both the policy on the part of the intended targets (e.g., Voas, Lange, and Tippetts, 1998). In the case of policies with deterrent components, enforcement is also key. Awareness and knowledge of policies on the part of those charged with enforcement and public support for the policies may also be important for effective implementation. Law enforcement officers and community leaders may often perceive little popular support for such policies or their enforcement (Wagenaar and Wolfson, 1994, 1995). The difficulty of implementing effective policies in the face of public opposition may be considerable. Public support may, in fact, be greater for those policies that are least effective in reducing drinking and drinking problems among youth. Surveys in Canada and the United States, for example, indicate that public support may be strongest for interventions such as reducing service to intoxicated patrons and treatment rather than those that control access to alcohol (Giesbrecht and Greenfield, 1999). The strategic use of media, however, may help overcoming such resistance and elicit public support for effective environmental interventions.

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Alcohol Prices and Traffic Safety

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How do alcohol beverage prices affect traffic fatalities? Economic theory predicts that alcohol consumption will be negatively related to price, and thus increases in price are expected, *ceteris paribus*, to reduce alcohol-related fatalities. Furthermore, price is an important policy variable, because it is affected by taxes and other policies, and—for some beverages in some states—price is actually set by alcohol control authorities. Schematically, the hypothesized relationships are: tax => price => consumption => fatalities.

While there is little dispute about the qualitative nature of these relationships, there is a wide range of quantitative estimates of the magnitudes involved at each step, and a further question about whether, taken together, the estimated magnitudes make sense. Many researchers in the United States have estimated reduced-form relationships based on state-level tax and fatality data, ignoring the intermediate relationships between taxes and prices, prices and consumption, and consumption and fatalities. Studies based on data from the 1970s and early 1980s often found a large, statistically significant negative relationship between state alcohol taxes and fatalities. However, several studies in the late 1990s failed to find significant relationships, and found that the estimates were sensitive to what other variables were included, or were implausible.¹

A large number of studies have addressed the relationship between alcohol consumption and price, but only a few are focused on the high levels of intoxication associated with most alcohol-related fatalities (Simpson et al., 2004). The few studies that estimated a price–fatality relationship yielded inconsistent results.² However, two recent studies have demonstrated that the failure to detect a robust and statistically significant relationship between beverage prices and fatalities may result from the poor quality of the available price data.³ Even after correcting for measurement error, however, substantial uncertainty remains about the true magnitude of price effects.

Section II of this paper provides an overview of trends in U.S. traffic fatalities, alcohol consumption, and beverage pricing. Section III reviews a number of studies relating fatalities to beer taxes. Section IV considers whether the available tax or price data are better indicators of the price of alcohol. Section V discussed two recent studies utilizing price data and section VI concludes.

RECENT TRENDS

Motor vehicle traffic crashes are the leading cause of death in the United States for the age group four through 34, and rank third overall in terms of years of life lost (Subramanian, 2006). However, fatality rates showed substantial improvement over the last quarter century (Table 1).⁴ Per-capita fatality rates fell by about 20% despite rising numbers of drivers, vehicles, and miles driven per person. Traffic fatality rates for youths age 16 to 20, which are more than twice as high as for the general population, show a similar decline (NHTSA, 2005, Table 6). In addition, alcohol involvement fell as a proportion of total fatalities, leading to a decline in the alcohol-involved fatality rate of 50%.⁵

TABLE 1 U.S. Traffic Fatality Rates

	All Fatalities				Alcohol Involved	
	per 100,000	per 100,000	per 100,000	per 100,000,000		per 100,000
Year	Population	Drivers	Vehicles	Vehicle Miles	Percent	Population
1982	19.0	29.3	29.1	2.76	60	11.4
1983	18.2	27.6	27.7	2.58	58	10.6
1984	18.8	28.5	27.9	2.57	56	10.5
1985	18.4	27.9	26.4	2.47	53	9.8
1986	19.2	28.9	27.3	2.51	54	10.4
1987	19.2	28.7	26.9	2.41	52	10.0
1988	19.3	28.9	26.5	2.32	51	9.8
1989	18.5	27.5	25.2	2.17	49	9.1
1990	17.9	26.7	24.2	2.08	51	9.1
1991	16.5	24.6	22.3	1.91	49	8.1
1992	15.4	22.7	21.2	1.75	47	7.2
1993	15.6	23.2	21.3	1.75	45	7.0
1994	15.6	23.2	21.2	1.73	43	6.7
1995	15.9	23.7	21.2	1.73	42	6.7
1996	15.9	23.4	20.9	1.69	42	6.7
1997	15.7	23.0	20.6	1.64	40	6.3
1998	15.4	22.5	20.0	1.58	40	6.1
1999	15.3	22.3	19.6	1.55	40	6.1
2000	14.9	22.0	19.3	1.53	41	6.1
2001	14.8	22.1	19.1	1.51	41	6.1
2002	14.9	22.1	19.1	1.51	41	6.1
2003	14.8	21.9	18.6	1.48	40	5.9
2004	14.5	21.4	17.9	1.44	39	5.7
% change	-23%	-27%	-38%	-48%	-35%	-50%

Source: NHTSA, *Traffic Safety Facts 2004*.

Consistent with the fall in alcohol-involved fatalities, alcohol consumption declined (Table 2). Among the general population, per capita consumption of ethanol fell from a peak around 1980 to a trough in the middle 1990s, before rising again in the last few years. Over the whole period, per capita alcohol consumption declined 16% to 20% depending on the measure used. Youth drinking declined even more although it remains high. For example, 30-day usage rates for 12th graders declined from 72% in 1980 to 47% in 2005.

TABLE 2 Alcohol Consumption

	Total Population	Youth	
	Ethanol per Capita	30-Day Use	
	Gallons/Capita	Grade 12	
Year	Age 14+	Age 21+	Percent
1978	2.71	3.27	72.1
1979	2.75	3.30	71.8
1980	2.76	3.30	72.0
1981	2.76	3.28	70.7
1982	2.72	3.20	69.7
1983	2.69	3.15	69.4
1984	2.65	3.09	67.2
1985	2.62	3.04	65.9
1986	2.58	2.98	65.3
1987	2.54	2.92	66.4
1988	2.48	2.84	63.9
1989	2.42	2.79	60.0
1990	2.45	2.80	57.1
1991	2.30	2.62	54.0
1992	2.30	2.61	51.3
1993	2.23	2.53	48.6
1994	2.18	2.48	50.1
1995	2.15	2.44	51.3
1996	2.16	2.46	50.8
1997	2.14	2.45	52.7
1998	2.14	2.45	52.0
1999	2.16	2.48	51.0
2000	2.18	2.49	50.0
2001	2.18	2.49	49.8
2002	2.20	2.51	48.6
2003	2.31	2.65	47.5
2004			48.0
2005			47.0
% Change	-15%	-19%	-35%

Sources: Lakins et al., 2005. *NIAAA Surveillance Report No. 73*; Johnston et al., 2005. *Monitoring the Future*, Table 16.

What role has price played in reducing consumption and fatalities? At first glance the answer would seem to be “not much.” Adjusted for inflation, beverage prices for off-premise consumption [“at home” according to the U.S. Bureau of Labor Statistics (BLS)] declined by amounts ranging from 15% for beer to 31% for wine (Table 3).⁶ Alcohol prices for on-premise

TABLE 3 Alcohol Beverage Prices

Real (Inflation Adjusted) Price Indexes: 1982–1984 = 100						
	Home				Away	Home + Away
Year	Beer	Wine	Spirits	All	All	All
1978	106.7	116.0	125.8	114.7	109.4	113.7
1979	105.9	113.5	117.2	111.0	106.3	110.1
1980	102.9	108.6	109.0	105.9	100.6	104.9
1981	100.0	105.8	104.4	102.4	99.1	101.8
1982	98.7	104.0	101.8	100.5	98.7	100.2
1983	101.1	100.9	100.8	101.0	100.2	100.8
1984	100.3	95.4	97.6	98.6	101.2	99.1
1985	99.2	93.1	97.9	97.8	103.3	98.9
1986	99.2	93.4	103.4	99.7	108.1	101.4
1987	97.6	93.0	100.7	98.2	108.6	100.4
1988	96.7	91.1	98.1	96.5	110.4	100.3
1989	95.3	89.4	96.7	95.1	110.8	99.6
1990	94.6	87.5	96.2	94.1	110.5	98.9
1991	101.6	95.4	102.2	101.2	115.2	104.8
1992	102.3	94.5	100.9	100.9	115.8	105.0
1993	99.1	92.7	99.1	98.4	115.8	103.5
1994	96.8	89.9	97.4	96.2	115.8	102.2
1995	94.4	87.7	95.6	93.9	115.8	101.0
1996	93.9	88.8	94.0	93.6	116.4	101.0
1997	92.3	90.7	94.0	93.1	118.0	101.4
1998	91.1	90.4	93.7	92.4	119.6	101.7
1999	91.2	89.7	93.8	92.3	120.6	101.9
2000	91.1	88.0	94.3	91.8	120.3	101.5
2001	90.7	85.5	94.9	91.0	121.5	101.2
2002	91.6	84.7	95.3	91.2	123.7	102.1
2003	91.6	83.2	94.1	90.5	124.2	101.7
2004	92.4	81.4	92.8	90.1	125.3	101.7
2005	90.3	80.0	90.8	88.2	125.2	100.3
% Change	-15%	-31%	-28%	-23%	14%	-12%

Source: BLS, 2006.

consumption (“away” according to BLS) rose by 14%. A composite index of on- and off-premise alcohol prices declined by 12%. Since lower prices would be expected to increase consumption rather than decrease it, these data provide little support for the notion that alcohol prices were instrumental in the observed declines in consumption and fatality rates.

However, it would be wrong to conclude on this basis that alcohol prices are necessarily ineffective in reducing traffic fatalities. Rather, these data suggest the importance of controlling for non-price factors when examining alcohol-related traffic safety data. These factors include demographics such as age, education, and religious preference; non-price alcohol policies such as the legal drinking age, blood alcohol content levels, dram shop laws, administrative license revocation, government monopoly, and outlet density; the degree of enforcement including the magnitude and certainty of penalties for driving and drinking (likelihood of being caught, prosecuted, and penalized); and educational and social factors including public campaigns against drinking and driving. Many of these factors changed dramatically in the last 25 years and these factors—rather than price—have been the main causes of declines in alcohol-involved fatality rates.⁷ But price could still play a significant role. That is, alcohol-related fatalities might, in principle, have declined even more if prices had risen rather than fallen. The remainder of this paper assesses this possibility.

Alcohol Taxes and Traffic Fatalities

Early Econometric Results

Studies based on data from the 1970s and early 1980s often found a large, statistically significant negative relationship between alcohol taxes and fatalities, especially for youth. For example, Chaloupka et al. (1993), using data from 1982 to 1988, estimated that a 100% increase in the federal beer tax—from 16 cents to 32 cents per six pack—would reduce fatalities among 18 to 20 year olds by almost 12%. In a pair of papers using data from the 1977 to 1981 period, Saffer and Grossman (1987*a,b*) estimated that doubling beer taxes would reduce youth fatalities by 17% to 27%. Estimated impacts on adults were more modest but still substantial. For example, Chaloupka et al. (1993) estimated that doubling the federal beer tax would reduce total fatalities (for all age groups) by about 4% and alcohol-involved driver fatalities by almost 10%.⁸

Some of these estimates seem extraordinarily large for several reasons. First, the magnitude of the proposed tax increase was quite modest—only about 2.5 cents per 12-oz can of beer, or about 6% of the retail price (Young and Likens, 2000).⁹ Second, only about one half of fatalities during this time period involved alcohol. Thus, alcohol-involved fatalities would have to fall by approximately 24% to produce a fall in overall youth fatalities of 12%. Third, an increase in beer taxes would create incentives for consumers to substitute other beverages—wine or spirits—or to purchase beer with greater alcohol content or to purchase alcohol in less expensive venues (Gruenewald, Millar, Ponicki, and Brinkley, 2000). Thus, the impact a beer tax increase would have on the volume of beer consumption would be at least partially offset by substitution effects.

More Recent Estimates

A number of more recent studies have found much smaller and sometimes insignificant relationships between beer taxes and traffic fatalities. Mast et al. (1999) estimate a structural

model in that beer taxes affect consumption that in turn affects traffic fatalities. They find that a doubling of beer taxes would reduce the alcohol-involved driver fatality rate by 0.7% to 1.2%. Young and Likens (2000) found no significant relationships between beer taxes or beer prices and total, youth, and alcohol-involved fatalities. Dee's (1999) reduced form estimates of tax effects on youth fatalities are the "wrong" sign (i.e., positive) and insignificant when state-specific time trends are included. In addition, Dee estimates separate tax effects for daytime and nighttime fatalities. The rate of alcohol involvement is 3.4 to 7.5 times as high at night as in the day, so the estimated tax effects should be much larger during the night. However, Dee finds an "implausibly large" estimated effect of beer taxes for daytime fatalities. Specifically, Dee estimates that doubling the beer tax would reduce daytime fatalities by 38%. However, only about 10% to 20% of these fatalities involve alcohol. Similarly, Dee and Evans (2001) estimate that doubling the beer tax would reduce both day and night fatalities for teens by 25% to 30%, despite the facts that: (a) overall alcohol involvement in teen fatalities is only about 25%, and (b) alcohol involvement at night is much higher than during the day.

What explains the differences between the earlier estimates and the more recent works? There is no single definitive answer. Mast et al. found that the estimates were sensitive to sample period, with smaller estimated effects after 1988. Grube and Stewart (2004) echo this view, suggesting that increases in the minimum legal drinking age and other environmental, economic and social factors altered the impact of tax increases. In particular, the price of beer would have a more modest impact on teen drinking when such drinking is illegal. However, Mast et al., Dee, Young and Likens, and Dee and Evans all argue that the problems are more fundamental—that alcohol taxes are likely to be correlated with other variables that the statistician is unable to observe or accurately measure. Thus, alcohol taxes may be correlated with enforcement, educational campaigns, and/or social attitudes that are not captured in the control variables. As a result, estimated tax effects suffer from omitted variable bias.¹⁰

Taxes Versus Prices as Measures of Beverage Cost

Another issue is whether taxes are good measures of the price of alcohol. Economic theory suggests that prices—rather than taxes—directly affect behavior, and thus prices are the better indicators of the cost of alcoholic beverages. However, the available price data contain substantial measurement error. Many studies use the price information collected by the American Chamber of Commerce Research Association (ACCRA) for its quarterly surveys of the cost of living in various cities around the United States.¹¹ The surveys report retail prices, exclusive of sales taxes, for specific beverages. However, the beverage definitions have changed over time, requiring adjustments to create a consistent time series. In addition, the data may not be consistent across states and over time because members of local chambers of commerce are responsible for collection and reporting. Beer and wine price data are only available since 1982. Finally, there are significant gaps in the data for various states and years.

Consequently, taxes could, in principle, be a better indicator of the prices consumers face than the available price data. However, taxes are also measured with error, particularly taxes on spirits. In 18 states liquor is sold through state stores and is subject to ad valorem markup or excise taxes. In these "control" states, the markup is in part a tax, because the state stores earn a profit, but it is difficult to determine the implicit tax rate from the normal costs of wholesaling and retailing liquor. The remaining "license" states levy a per-unit excise tax.¹² Tax rates also

vary according to alcohol content, place or volume of production, size of container, place purchased (on or off premise), and there may be case or bottle handling fees.

These problems with price data in general, and spirits and wine taxes in particular, led some researchers to conclude that beer taxes alone are the best available indicators of the cost of alcohol.¹³ However, beer tax data share some of the problems of spirits and wine data. Taxes vary by alcohol content (e.g., 3.2 beer versus stronger beer), size of container (e.g., cans versus barrels), on premise versus off premise, etc. Beer and other beverages are also subject to local taxes, which may vary by location within a state.

Beer taxes (or prices) may also be a poor indicator of the overall price of alcohol, because beer consumption represents only about half of total alcohol consumption. Malt beverages constitute 87% of consumption measured in terms of gallons of beverage, but only about 56% in terms of consumption of pure alcohol (ethanol). Alcohol consumption in the form of spirits is more than 30% of the total, and wine more than 10%.¹⁴

State taxes may also be a poor measure of prices because they are a relatively small part of beverage prices, and other factors such as transportation cost, competitive environment, or local costs of distribution may be more important. For example, distance to a brewery plays an important role in beer pricing.

Tables 4, 5, and 6 present data on state alcohol taxes and prices from the fourth quarter of 1997. Consider first the ACCRA price data in Table 4.¹⁵ The left side presents the data in “natural” units, i.e., as dollars per bottle or per six pack, and the right side presents the prices in units of dollars per gallon of pure ethanol. There is a significant amount of interstate variation in prices, as indicated by the range of observed prices.¹⁶

State taxes are only a very small part of retail prices (Table 5).¹⁷ State excise taxes constitute only about 4% of spirits prices, 5% of wine prices, and 3% of beer prices. The average state excise tax on a gallon of pure ethanol is \$6.50, which is about 3.5% of the average price.¹⁸

Correlations between the individual beverage prices and taxes are not very high, even for each beverage’s own tax (Table 6).¹⁹ The tax on beer is actually negatively correlated with the price of beer. The correlations of the beer tax with the other prices are also small and only .03 with the alcohol price index. In fact, the beer tax has the lowest correlation with the price of alcohol of any of the taxes.

Young and Bielinska-Kwapisz (2002) also show that national averages of the ACCRA price data display the same trends over time as the corresponding BLS series for beer, wine, and spirits. Beer taxes, on the other hand, do not track BLS beer or alcohol price series very well at all. Thus, beer taxes alone appear to be a poor measure of the price of alcohol. However, a combination of beer, wine, and spirits taxes and markups explain about 30% of the variation in alcohol prices in pooled cross-section time series data, suggesting that a combination of taxes does provide significant information about retail beverage prices.

Young and Bielinska-Kwapisz (2002) also examine how tax changes are translated into price changes. They find strong evidence of over shifting. That is, retail beverage prices increase more than one for one with taxes. A \$1 increase in excise taxes on beer is estimated to increase retail prices by \$1.71, and a \$1 increase in excise taxes on spirits is estimated to increase retail prices by \$1.61 to \$1.64.²⁰ Furthermore, the rise in prices appears to be completed within the 3-month interval of the data.²¹

TABLE 4 Alcohol Prices

	Per Bottle or Six Pack				Per Gallon of Ethanol			N
	Unit	Mean	Min	Max	Mean	Min	Max	
Spirits	750 ml	\$18.35	\$15.07	\$22.05	\$231.50	\$190.13	\$278.24	48
Wine	1.5 L	\$5.73	\$4.62	\$6.80	\$131.42	\$105.91	\$156.04	48
Beer	6-12 oz	\$4.35	\$3.73	\$5.38	\$171.97	\$147.28	\$212.50	48
Alcohol	—	—	—	—	\$185.86	\$163.67	\$222.31	48

Notes: Data are for 50 states and District of Columbia in 1997:IV. Missing: Hawaii, Maine, and New Jersey. New Hampshire data are for 1997:I. Price per gallon of ethanol based on alcohol by volume—spirits: 40%; wine: 11%; beer: 4.5%. Alcohol price based on (1990) consumption shares: spirits—31.5%; wine: 12%; beer: 56.4%. Source: Young and Bielinska-Kwapisz, 2002.

TABLE 5 State Alcohol Taxes

	Per Bottle or Six Pack				Per Gallon of Ethanol			N
	Unit	Mean	Min	Max	Mean	Min	Max	
Spirits	750 ml	\$0.72	\$0.30	\$1.29	\$9.05	\$3.75	\$16.25	33
Wine	1.5 L	\$0.29	\$0.04	\$0.89	\$6.76	\$1.00	\$20.45	46
Beer	6-12 oz	\$0.14	\$0.01	\$0.52	\$5.42	\$0.44	\$20.67	51
Alcohol	—	—	—	—	\$6.50	\$2.70	\$17.89	33

Notes: See notes to Table 4. Missing: Spirits and alcohol—18 liquor-control states (Alabama, Idaho, Iowa, Maine, Michigan, Mississippi, Montana, New Hampshire, North Carolina, Ohio, Oregon, Pennsylvania, Utah, Vermont, Virginia, Washington, West Virginia, and Wyoming). Missing: Wine: 5 wine-control states (Mississippi, New Hampshire, Pennsylvania, Utah, Wyoming).

TABLE 6 Price–Tax Correlations

		Prices				Taxes			
		Spirits	Wine	Beer	Alcohol	Spirits	Wine	Beer	Alcohol
Prices	Spirits	1.00							
	Wine	0.35	1.00						
	Beer	0.23	0.45	1.00					
	Alcohol	0.74	0.61	0.82	1.00				
Taxes	Spirits	0.20	0.19	0.12	0.21	1.00			
	Wine	0.36	0.25	0.01	0.26	0.61	1.00		
	Beer	0.22	0.20	-0.18	0.03	0.60	0.60	1.00	
	Alcohol	0.28	0.26	0.10	0.24	0.81	0.77	0.93	1.00

Notes: See Notes to Tables 4 and 5. Sample sizes vary by cell.

Alcohol Prices, Consumption, and Traffic Fatalities

If beer taxes are poor measures of the price of beverage alcohol, spirits taxes are inherently hard to measure in control states, and retail price data are plagued with measurement error, what is the best approach to estimating the relationship between alcohol prices and traffic fatalities? Measurement error in the price data implies that the ordinary least squares (OLS) estimator commonly used in regression analysis is biased and inconsistent (Greene, 2005, Section 5.6). In addition, beverage prices may be endogenous in the sense that higher demand may result in higher market prices (Manning et al., 1995). In simple models, both measurement error and endogeneity cause the estimated price response to be biased away from negative values. That is, the conventional OLS estimator may substantially underestimate how much consumers respond to a price increase by decreasing consumption or drinking and driving or both.

Biases due to measurement error in the price data can be eliminated by standard two-stage estimation methods if a set of proper instrumental variables can be found. First, the alcohol price data are regressed on the tax and other variables, and the predicted prices are retained. In the second step, the responses of alcohol consumption and fatalities to beverage prices and other variables are estimated, using the predicted prices from the first step as right-hand side variables. The important point is that these predicted prices are cleansed of measurement error and demand effects, so that the resulting estimator is unbiased in large samples.

For these techniques to be effective, the tax variables must satisfy two properties. They are significantly correlated with true alcohol prices, and uncorrelated with the disturbances in the consumption equation. Young and Bielinska-Kwapisz (2002) show that state and federal excise taxes and markups explain about 30% of the variation in alcohol prices in pooled cross-section time series data similar to that employed in this study, and thus satisfy the first property. However, it is possible that state taxes and other alcohol policies reflect unmeasured policies or attitudes toward alcohol, which are captured in the disturbance term of the consumption equation. In particular, taxes may be higher in states in which there is stronger anti-alcohol sentiment, or taxes may change over time in response to changes in policies and attitudes. If this is the case, taxes are correlated with the disturbance and not proper instrumental variables.²²

Young and Bielinska-Kwapisz have applied these methods to the estimation of alcohol consumption (2003) and traffic fatalities (2006). The results strongly confirm the presence of measurement error in the price data and indicate that OLS estimators are seriously biased toward finding little or no price effects. For example, when OLS is employed, the estimated price elasticity of demand for alcohol ranges from plus 0.03 to -0.35 and is statistically significant in only one of three specifications. Using the two-stage estimation methods, the estimated price elasticity is substantially larger, ranging from -0.53 to -1.24 , and is always statistically significant.

Table 7 reports results for six adult and teen fatality rates. The column labeled “F-value” reports Hausman tests for measurement error and/or endogeneity of prices (Davidson and MacKinnon, 1989, 1993). The null hypothesis of exogeneity is rejected at the 1% level for five of the six fatality rates. As the last two columns indicate, correcting for measurement error/endogeneity has a profound impact on the estimated price effects. OLS estimates are positive for five of the six fatality rates, and three of the estimates are statistically significant. Taken at face value, these estimates imply that increases in alcohol prices are positively associated with traffic fatalities. However, the two-stage estimates imply quite the opposite: All six of the estimates are negative, and five of the six are significant at the 5% level.

TABLE 7 Tests for Endogeneity and/or Measurement Error in Prices

Fatality Rate	F-value (Significance Level)	Price Coefficient t-ratio	
		OLS	IV
All Ages All Times	28.4 (.00)	.16 2.2	-.58 3.4
All Ages Weekend Nights	17.3 (.00)	.11 1.1	-.69 3.0
All Ages Other Times	12.6 (.00)	.29 3.5	-.39 2.1
Ages 16–20 All Times	15.3 (.00)	.08 .7	-.90 3.1
Ages 16–20 Weekend Nights	.4 (.52)	-.10 .5	-.35 .8
Ages 16–20 Other Times	12.7 (.00)	.44 2.6	-.93 2.2

Source: Young and Bielinska-Kwapisz, 2006.

The estimated magnitudes suggest substantial effects of prices on fatalities. A 10% increase in alcohol prices is predicted to reduce total fatalities by 5.8%. The estimated effect is somewhat larger for weekend night fatalities (6.9%) and smaller for other times (3.9%). The estimated impact on all youth fatalities (9%) is larger than for the total population. Less plausibly, the estimated impact on weekend night fatalities among youth (3.5%) is smaller than the impact on youth at other times (9.3%), although the difference is not significant at the .05 level.

Young and Bielinska-Kwapisz (2006) also estimate the structural relationship between per capita alcohol consumption and traffic fatalities. The results are broadly similar to those for price (Table 8). Exogeneity is rejected at the 10% significance level or less for five of the six fatality rates, and two-stage estimates indicate larger effects than do OLS estimates. For example, using OLS, a 10% increase in per capita alcohol consumption is associated with a 9.9% increase in fatalities, while the two-stage estimate is 11.3%. The other estimated effects range from 10.2% to 14.1%. Somewhat implausibly, the estimated effects are smaller on weekend night fatalities than on fatalities at other times, particularly for youth, although the difference is again not statistically significant.

DISCUSSION OF ESTIMATES

There is strong evidence in most specifications that fatalities are in fact negatively and significantly related to the price of alcohol, *ceteris paribus*. The point estimates imply the price-consumption elasticity, $E_{cp} = E_{fc}/E_{fp} = -.58/1.13 = -.51$. This value is within the range of price elasticities for aggregate alcohol consumption estimated in previous work (Leung and Phelps, 1993; Young and Bielinska-Kwapisz, 2003).

What do these estimates imply about the impact of alcohol taxes on traffic fatalities? The answer depends on the degree to which alcohol taxes are shifted forward to retail prices, and on how important taxes are as a share of retail prices. As section IV described, Young and

TABLE 8 Tests for Endogeneity and/or Measurement Error in Consumption

Fatality Rate	<i>F</i> -value (Significance Level)	Consumption Coefficient	
		<i>t</i> -ratio OLS	IV
All Ages All Times	10.7 (.00)	.99 16.8	1.13 14.4
All Ages Weekend Nights	3.1 (.08)	.99 12.4	1.08 9.5
All Ages Other Times	12.1 (.00)	.91 12.9	1.11 11.7
Ages 16–20 All Times	12.6 (.00)	.97 9.2	1.29 8.9
Ages 16–20 Weekend Nights	1.4 (.23)	.86 5.0	1.02 4.3
Ages 16–20 Other Times	13.8 (.00)	.85 5.3	1.41 6.3

Source: Young and Bielinska-Kwapisz, 2006.

Bielinska-Kwapisz (2002) find that spirits, beer and wine taxes are over shifted—retail prices rise more than one-for-one with an increase in taxes. However, excise taxes are only 11% to 18% of retail prices. Thus, the 1991 change in federal excise taxes, which doubled the beer tax from 16 cents per six pack to 32 cents and increased the wine tax by 500%, increased retail prices by only about 6%. Based on a price-fatality elasticity of .58, the predicted decline in total fatalities is about 3% and one-half percent.

Ignoring the increase in the wine tax for simplicity, the implied elasticity of fatalities with respect to the beer tax is 0.06.²³ This figure is about one-quarter lower than Evans et al.'s (1991) estimate of .08, and about one-half of Ruhm's (1996, Table 2) estimate of .11. Chaloupka et al. (1993, p. 181) estimated that doubling the federal beer tax would have reduced fatalities by 3.9%, similar to the finding in this paper.

The estimated tax elasticity for teen fatalities is about half again as large (.09), because the teen price elasticity of fatalities is estimated to be that much larger (Table 6). This value is substantially smaller than some previous estimates. For example, Ruhm's (1996, Table 4) tax elasticity for 18 to 20 year olds is twice as high (.17 to .21), and Chaloupka et al. (1993, p. 181) report that doubling the federal beer tax would reduce fatalities among 18 to 20 year olds by 11.8%, implying an even larger tax elasticity of .21.

Even these more modest estimates obtained by Young and Bielinska-Kwapisz should be regarded with caution, however, for some of the same reasons cited by Dee (1999) and Mast et al. (1999). One reason is that they still seem too large. Only a minority of fatalities involves alcohol; currently the proportion is 30% [according to the National Institute on Alcohol Abuse and Alcoholism (NIAAA)] to 40% (according to NHTSA). Thus, a 3.5% reduction in total fatalities would require a reduction in alcohol involved fatalities of 2.5 to 3.3 times as much. Second, the pattern of estimated price and consumption effects across the different fatality measures is sometimes counterintuitive. Teen fatalities on weekend nights are apparently less responsive to the price of alcohol than are fatalities at other times, and total fatalities on weekend nights are apparently less responsive to alcohol consumption than fatalities at other times. One wonders if nonalcohol-involved fatality rates are also correlated with beer taxes. In addition,

point estimates of price effects are sensitive to what other control variables are included, with much more modest estimates obtained when some of the insignificant variables are excluded.

A related concern is that alcohol taxes and other policies may reflect underlying attitudes toward alcohol, or be correlated with unmeasured policy measures intended to curb fatalities, and thus be improper instrumental variables. In particular, to the extent that states simultaneously took action on a number of fronts to reduce alcohol abuse—say by increasing taxes, legislating stricter and more certain penalties for driving under the influence, stepping up enforcement and educational efforts, and mobilizing citizen groups—then the estimated effects of taxes are likely to overstate their actual deterrent effects.

The problem of “endogenous policy” is not confined to this study. Whether a researcher takes a “structural” approach as is done here or instead estimates a “reduced form” by regressing fatalities directly on taxes, the resulting estimators are biased and inconsistent if taxes are endogenous. Indeed, all of the most frequently cited estimates of the impact of alcohol taxes rely on the assumption that taxes are exogenous. Thus, all of these studies may be biased, and a more accurate assessment will not be possible until the determinants of policy are more fully understood and estimation procedures are modified accordingly. This study has substantially resolved the discrepancy between estimates based on tax and price data, but it remains to be seen whether the tax data themselves are appropriate as exogenous variables.

NOTES

1. For examples, Cook (1981), Chaloupka et al. (1993), Saffer and Grossman (1987a,b), and Ruhm (1996) find large negative relationships between taxes and fatalities, while Dee (1999), Mast et al. (1999), and Young and Likens (2000) fail to find a robust relationship.
2. Sloan et al. (1994) find that alcohol price is negative and significant at the 10% level in one of three specifications, but that it is sensitive to the inclusion of time-fixed effects. Price effects in Young and Likens (2000) are small, negative, and statistically insignificant.
3. Young and Bielinska-Kwapisz (2003) and (2006).
4. Worldwide trends are described in Sweedler et al. (2004).
5. NIAAA estimates alcohol involvement using a different methodology. Although the NIAAA estimates for each year are lower than NHTSA’s estimates, they show the same pattern of decline since 1980. See <http://pubs.niaaa.nih.gov/publications/surveillance71/fars03.htm>.
6. Prices that are adjusted for inflation measure what the consumer gives up to obtain, say, a beer. A decline in real beer prices means that nominal beer prices rose less rapidly than the prices of other things that consumers buy.
7. Grube and Stewart (2004) review and assess some of these factors.
8. See also Ruhm (1996).
9. The Consumer Price Index (CPI) has just about doubled since 1982-1984, so the increase amounts to about a nickel in 2006 dollars.
10. A related issue is that the time series components of the data may be nonstationary and thus lead to spurious statistical results (Baltagi and Kao, 2000).
11. For examples, the ACCRA data were used in studies of alcohol consumption by Nelson (2000), Beard et al. (1997), Kenkel (1993), and Gruenewald et al. (1993), an analysis of traffic accidents, homicides, suicides, and other deaths by Sloan et al. (1994b), and in a study on alcohol-related fatalities by Young and Likens (2000).
12. A similar but less severe situation occurs with wine. Five states control wine sales, while the remainder levy per-unit excise taxes.
13. See Chaloupka et al. (1993), p. 169.

14. Source: Beer Institute (1997), Tables 38, 40, and 42. Estimates are based on 1990 consumption with alcohol content of spirits (40%), beer (4.5%), and wine (11%). Lakins et al. (2005) provide updated figures for 2003. Beer's share of total ethanol consumption = 55%; wine's share = 15%; and spirit's share = 30%.
15. The beverages were a six pack of Budweiser or Miller-Lite in 12-oz. containers, a 750-ml bottle of J&B Scotch, and a 1.5-L bottle of Gallo or Livingston Cellars Chablis. State-level data are calculated by averaging the figures from one or more cities within each state. The sample includes 47 states plus Washington, D.C. The means reported in the table are simple averages of the state figures.
16. Wine is the cheapest, then beer, and spirits are the most expensive. However, these reflect the relative quality of the particular brands sampled by ACCRA: J&B Scotch is a fairly high-quality spirits beverage, while Gallo Sauvignon Blanc is not of the same standing among wines. CPI data—based on “all malt beverages” for beer, vodka for spirits, and “table” wine—reverse the ordering; spirits are the cheapest, then beer, and finally wine.
17. The 18 liquor control states are excluded from the spirits calculations, and similarly for the five wine control states. Maryland is treated as a license state, even though Montgomery County operates as a control jurisdiction.
18. The highest excise taxes are on spirits, then wine, and the lowest on beer. The differences are not a function of the quality of the particular products, since these taxes are specified per unit of beverage, rather than as a percentage of the price.
19. Sample sizes vary by cell because of missing price and tax data. For example, the correlation between beer prices and spirits taxes is calculated using data just from those states that report both beer prices and spirits taxes.
20. Estimates for wine taxes are less robust but still generally exceed one.
21. Kenkel (2005) finds even larger over shifting in Alaska, particularly in on-premise establishments.
22. See Manning et al. (1995), footnote 4. Kubik and Moran (2003) provide evidence that changes in beer taxes are endogenous. Brown et al. (1996) find that county-level prohibitions on alcohol sales are endogenous. Eisenberg (2003) concludes that existing estimates of the effects of .08 laws and graduated licensing programs are overstated due to endogeneity.
23. Federal beer taxes doubled in 1991 but state taxes were largely unchanged. Thus combined federal and state taxes increased by 56%.

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APPENDIX

Fatality Elasticities

An elasticity is a measure of proportional response. For example, if the price elasticity of alcohol consumption with respect to price is equal to -0.5 , it means that a 10% increase in price will cause consumption to fall by 5%, other factors held constant. The elasticity of fatalities with respect to alcohol taxes depend on several factors, including the extent to which taxes are shifted (marked up) to the retail level, the importance of taxes as a proportion of retail prices, the share of the particular beverage (beer, wine, or spirits) in total consumption, and so forth.

1. Price of i th beverage depends on excise tax t_i and markup λ_i :

$$P_i = a_i + \lambda_i t_i$$

Note: $\lambda > 1$ indicates taxes are over-shifted (markup > 1).

$$\Rightarrow \frac{d \ln P_i}{d \ln t_i} = \frac{dP_i}{dt_i} \frac{t_i}{P_i} = \lambda_i \mu_i$$

where $\mu_i = t_i / P_i =$ tax as proportion of price.

In words, the elasticity of the price of the i th beverage with respect to the i th excise tax is equal to the markup times the ratio of the tax to the price.

2. Alcohol price index (Stone):

$$\ln P = \sum_i \theta_i \ln P_i$$

where $i =$ beer, wine, spirits, and $\theta_i = \frac{P_i C_i}{\sum_i P_i C_i}$ is the share of beverage i in total expenditure on alcohol.

$$\Rightarrow d \ln P = \sum_i \theta_i \lambda_i \mu_i d \ln t_i$$

In words, the proportional change in the price of alcohol is equal to the sum of the proportional changes in the excise taxes, weighted by the respective products of their markups, tax-price ratios, and shares in alcohol expenditure.

If only one tax changes, the elasticity of the price of alcohol with respect to that tax is:

$$\frac{d \ln P}{d \ln t_i} = \theta_i \lambda_i \mu_i$$

For example, in the year 2000 beer was 63% of alcohol expenditure, the markup is estimated as 1.70, and combined state and federal excise taxes were approximately 6.5% of retail prices (Young and Bielinska-Kwapisz, 2002, 2006). This implies that a doubling of both state and federal beer taxes would increase overall alcohol prices by about 7%.

3. Consumption elasticity with respect to price:

$$\varepsilon_{CP} \equiv \frac{d \ln C}{d \ln P}$$

For example, Young and Bielinska-Kwapisz (2003) estimate that the elasticity of aggregate alcohol consumption with respect to price in the range of -1.24 to -0.53 . That is, a 10% increase in the price of alcohol is expected to reduce consumption by 12.4% to 5.3%.

4. Fatality elasticities:

- a. with respect to consumption:

$$\varepsilon_{FC} \equiv \frac{d \ln F}{d \ln C}$$

For example, Young and Bielinska-Kwapisz (2006) estimate that a 10% increase in alcohol consumption is associated with a 10.8% to 11.3% increase in fatalities.

b. with respect to the price of alcohol:

$$\varepsilon_{FP} \equiv \frac{d \ln F}{d \ln P} = \varepsilon_{FC} \varepsilon_{CP}$$

For example, Young and Bielinska-Kwapisz (2003, 2006) estimate that a 10% increase in alcohol price is associated with a 3.1% to 5.8% decrease in fatalities.

c. with respect to tax on beverage i :

$$\varepsilon_{Ft_i} \equiv \frac{d \ln F}{d \ln t_i} = \varepsilon_{FC} \varepsilon_{CP} \frac{d \ln P}{d \ln t_i} = \varepsilon_{FC} \varepsilon_{CP} \theta_i \lambda_i \mu_i$$

For example, if a doubling of state and federal excise taxes on beer would increase overall alcohol prices by 7% (see No. 2 above), and the elasticity of fatalities with respect to the price of alcohol is 0.58 (see No. 3*b* above), then doubling the beer taxes would reduce fatalities by about 4%, i.e., the elasticity of fatality with respect to the beer tax is about 0.04.

Legal Framework for Alcohol Regulation in the United States

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Alcohol problems constitute a persistent public health and safety crisis in the United States, a leading contributor to premature deaths, disability, social disruption, and long-term health consequences. Young people suffer a disproportionate share of these problems, serving to emphasize the need for a national response to reduce the toll on individuals, communities, and society as a whole.¹ Of particular concern is the role of alcohol in motor vehicle crashes.

During the last three decades, there has been a significant shift in approaches taken to preventing alcohol problems, with the focus shifting from individual-based to community-based strategies.² Research has shown that alcohol problems occur within specific and definable contexts and that these contexts influence the extent and severity of the resulting problems. An impressive research literature now exists demonstrating that altering the context (or the environment) in which drinking takes place is an effective and efficient approach to alcohol problem prevention.³

Drinking environments can be influenced by alcohol-specific policies (e.g., changes in how alcohol is made available or how it is taxed) or nonspecific policies (e.g., seat belt and motorcycle helmet laws). These policies can be either formal (governmental laws and regulations) or informal (e.g., company employee policies regarding drinking on the job). The new approach to prevention, then, requires attention to policy: both researchers and policy makers must understand how policies are developed and implemented. What are the key elements of a given alcohol policy? How will it be interpreted by those responsible for its implementation and compliance? How do these variables compare across jurisdictions?

With regard to formal alcohol policies, answers to these questions require background and expertise in legal analysis. Yet legal studies have not had a major role in the alcohol field, and its development lags substantially behind other academic endeavors within the community systems research tradition. In general, alcohol policy research relies on simplistic understandings of governmental laws and regulations, including their interactions, interpretations, and implementation.

A common error for researchers is an assumption that an alcohol policy law in one jurisdiction is comparable to a similarly labeled law in another. For example, several states have beer keg registration laws, requiring alcohol retailers to register all purchasers of beer kegs prior to purchase as a strategy for reducing youth access to alcohol. A typical alcohol policy research study might compare states that have such laws with states that do not, or assess the impact of such a law over time in a single state, imputing results to laws in other states. An underlying assumption or goal is that the research will determine the effectiveness of the laws, providing guidance to policy makers. Yet a careful legal study will demonstrate that keg registration laws vary widely across states, so much so that some can be expected to have little effect on the beer keg market.⁴ States without such laws may allow local governments to enact them, so that most kegs in the state are registered even without a state law. Careful legal analysis is therefore required to avoid flaws in the research design and misinterpretation of the results.

This paper presents an overview of the legal framework for understanding formal alcohol policies in the United States, focusing specifically on policies regarding the manufacture,

distribution and sale of alcohol. It serves as a foundation for establishing a more robust study of alcohol legal policies as a field in its own right and for building effective communication among legal scholars, researchers, and policy makers involved in alcohol policy and the prevention of alcohol problems.

LAW AND THE POLICY DEVELOPMENT PROCESS

There are two fundamental legal dimensions to the development of formal alcohol policies: levels of government (federal, state, and local) and branches of government (legislative, executive/administrative, and judicial). Each component interacts with the others, creating a complex system of legal data for review and analysis of any given policy. The process usually (but not always) begins when a legislative body at one of the three levels of government enacts a law. For example, suppose a city council decides to enact a restriction on the density of alcohol outlets in a specific neighborhood. The city's authority to do so may be constrained by state and federal law. The administrative agency charged with implementing the ordinance must interpret the provisions and develop standards for its application. Its standards may be developed in either a formal, public process or an internal process that operates on a case-by-case basis. The judicial branch is responsible for resolving disputes regarding the ordinance's meaning and application as well as its legality under state and federal law.

Understanding the scope and application of the law, then, emerges from the actions of multiple players, often reacting to specific circumstances. Carrying this example further, suppose the local alcohol density law imposes a 300-ft limit between alcohol outlets but exempts existing outlets. What constitutes an existing outlet? How is the 300-ft limit to be measured? Does state law permit such restrictions? Are there due process concerns under the U.S. Constitution? The answers to these questions may emerge over time as the various actors review and implement the law in the context of its specific applications.

Levels of Government

Federal: Production Controls, Revenue, and Market Stabilization

The legal basis for federal and state regulation of the alcoholic beverage trade is derived from the United States Constitution, the bedrock of all policies in the country. Between 1919 until 1933, the Constitution's 18th Amendment prohibited "the manufacture, sale, or transportation of intoxicating liquors" in the United States and its territories.⁵ In 1933, National Prohibition was repealed by the 21st Amendment, which provides in part:

The transportation or importation into any State, Territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited.⁶

Repeal gave alcohol a unique status, the only consumer product specifically mentioned in the Constitution that gives primary authority for its regulation to the states. By its own terms, the amendment prohibits the federal government from mandating alcohol sales in any state, and a

federal law regarding the alcohol trade is apparently not operative in a state with a law that prohibits what the federal government would otherwise permit.

In practice, however, state power is more constrained by the federal government than would be expected given the language of the Constitutional amendment. Immediately following Repeal, the States largely deferred voluntarily to the federal government regarding the regulation of alcohol production and alcohol producers. Standards for purity, allowable ingredients, the regulation of advertising and marketing, and interstate transportation of goods are primarily federal domains as is the enforcement of laws against illegal production and bootlegging.⁷ Other parts of the Constitution provide a basis for the federal government's alcohol licensing and alcohol tax systems that operate concurrently with state systems. The federal government also directly controls the alcohol distribution system on federal lands, such as military bases and national parks.

Court decisions over the last 50 years have restricted the scope of the 21st Amendment and increased federal jurisdiction over the alcohol trade.⁸ As noted by the courts, the amendment must be interpreted in light of other U.S. Constitutional provisions. For example, states cannot restrain the alcohol industry's commercial speech rights protected under the First Amendment.⁹ The Interstate Commerce Clause has provided a basis for further restricting state jurisdiction. States cannot give commercial advantages to in-state producers and retailers that are not also available to out-of-state producers.¹⁰

One recent federal district court opinion ruled that the states cannot rely on the 21st Amendment as a basis for permitting violations of the Sherman Anti-Trust Act.¹¹ This appears to be a novel legal doctrine that would permit Congress to pass laws constraining states' rights provided under the Constitution. It reflects a general erosion of the repeal amendment in the eyes of federal courts, which are increasingly inclined to analyze state restraints on the alcohol trade in the same manner as restraints on any other consumer product.

The federal government has also used financial incentives and disincentives to influence state alcohol policies. For example, federal law requires that a portion of the federal highway funding be withheld from any state that allows the purchase or consumption of alcoholic beverages by persons under the age of 21 years.¹² States that enact various policies designed to prevent alcohol-related motor vehicle crashes are eligible for incentive grants.¹³

These federal initiatives designed to reduce alcohol problems contrast with the federal government's overall approach to regulating the alcohol trade. From its inception following Repeal, its primary goal has been to stabilize the alcohol trade, root out organized crime, and develop a reliable source of revenues from alcohol taxes. Public health and temperance play a secondary role. Primary federal jurisdiction is placed in the U. S. Department of Treasury rather than a health- or consumer-oriented federal agency, a clear indication of these priorities.

State Control: Focus on the Retail Sector

As noted above, the U.S. Constitution grants the states primary jurisdiction over the alcohol trade, although that authority has been substantially eroded over the seven decades since Repeal. States nevertheless retain considerable powers, particularly regarding alcohol retail sales and to a lesser extent, wholesale distribution. Following Repeal, state control rested on three primary regulatory strategies, two of where were designed to address major perceived problems with the alcohol trade prior and during Prohibition: (a) strict state control of the retail trade to promote temperance and deter criminal involvement; (b) strict separation of the manufacturing,

distribution, and retailing sectors of the industry, to prevent undo influence of the producers over wholesalers and retailers; and (c) taxation and price controls to raise much needed revenues.¹⁴

Two distinct retail licensing systems emerged from Repeal: control and license. Control states directly control a portion of the alcohol market through state wholesale outlets and off-sale retail state stores. These are staffed by state employees or contractors; the state establishes pricing as an administrative function and keeps the profits from these operations, usually sent to the state's general fund. License states rely on private businesses to operate the alcohol market, requiring them to obtain state licenses. Control states also have licensing systems for those parts of the market outside the jurisdiction of state wholesalers and retailers.

A detailed analysis of these state systems is beyond the scope of this paper. In general, the control state systems for distributing and retailing alcohol in state-run stores are gradually eroding, and there has been a gradual shift in these states from the state-owned to the privately owned and licensed businesses.¹⁵ Control systems have also veered substantially from their original purpose of temperance and focusing more on increasing state revenues.

License and control systems use state authority for three primary purposes: (a) restricting who may operate an alcohol business; (b) limiting the types, number and location of alcohol outlets; and (c) regulating the manner in which the outlets are operated. Most states put stricter controls on the distilled spirits market, reflecting the view inherited from Prohibition that distilled spirits constituted a much greater danger to public health and safety. In general, states have been steadily loosening these licensing restrictions.¹⁶

"Tied house" laws addressed the second purpose of state alcohol regulation. Before Prohibition, producers, particularly brewers, typically owned and operated retail establishments. Temperance advocates saw these tied houses as particularly problematic because the owners did not respond to community concerns and made profitability the primary focus of the operation. Tied house laws have also been eroded over the last 70 years as the rationale for them has been largely lost. This erosion has happened gradually, often through special interest legislation, and disputes largely arising between differing sectors within the industry seeking commercial advantages.¹⁷

Taxation and price controls, the third state regulatory strategy, has been designed primarily to raise revenues and stabilize the alcohol market rather than promote temperance, even though research suggests that higher prices reduce consumption and related problems.¹⁸ A major impetus for Repeal was the need at both the state and federal level for increased revenues during the Depression, and the realization that Repeal could direct profits from organized crime to the state and federal treasuries. States also adopted various price-control strategies, such as price posting and minimum discounts.¹⁹ In some states, such as California, fair trade statutes allowed producers to set standard retail prices, which the state would then enforce.²⁰ Price controls served to stabilize the retail market, protect small retailers, and limit competition. As with licensing and tied house laws, state and federal taxation and price controls have gradually eroded since Repeal, with tax rates steadily dropping relative to inflation. Alcohol taxes now constitute a very small percentage of state and federal revenue.²¹

In general, states have taken only minimal steps to regulate the practices of alcohol producers, deferring to federal oversight.²² This includes alcohol marketing practices, particularly as alcohol marketing has taken on national strategies through network television and radio, Internet and other forms of crossborder, nontraditional, advertising strategies. Although states have regulations of alcohol marketing on their books, they are mostly ignored by state regulators.

As this brief summary suggests, state regulation of the alcohol trade has gradually been relaxed since Repeal. As discussed in the next section, the process often occurs through special interest legislation, with each law addressing a very specific aspect of alcohol control. State systems also vary widely, from states such as Utah, which have very strict controls on the retail trade, to California, which has, at least until recently, a lax regulatory system.

Local Powers: State Preemption

As discussed above, state powers over the alcohol trade derive from the U.S. Constitution. Congress can limit state authority to some degree but is constrained by the relevant Constitutional provisions. Similarly, local powers to regulate the alcohol trade derive from state constitutional and legislative grants of authority.

The doctrine of “state preemption” plays a central role in this division of authority between state and local governments.²³ State preemption refers to state laws that prohibit local regulation of a given subject matter. As discussed in more detail below, the legislative intent to preempt local control is inferred by the courts, making its scope difficult to determine in most states. Preemption is a common alcohol (and tobacco) industry tactic to negate local regulatory strategies by alcohol and tobacco community activists, since these industries in general have more influence in state, as opposed to local, legislative bodies.²⁴

The extent to which a state preempts local powers regarding licensing and regulatory authority to local governments falls into one of the following broad patterns.

1. **Exclusive or near-exclusive state control.** Several states exclude local governments from retail licensing and regulation. States in this category will not recognize local zoning authority, even in land use matters, which is usually treated in other states as a municipal responsibility. North Carolina, for example, places exclusive power to license alcohol outlets in the state Commission on Alcoholic Beverage Control (ABC), which has “the sole power, in its discretion, to determine the suitability and qualifications of an applicant for a [alcohol retail] permit.”²⁵ Local governments can file written objections to proposed licenses, but their objections may be ignored.

2. **Exclusive state licensing authority, local regulatory authority.** In these systems, states retain exclusive licensing authority but allow local governments to influence the licensing decisions to some extent, typically through local zoning powers. States in this category vary widely in the degree to which they recognize local authority. Indiana law, for example, provides that city and town legislative bodies can influence the location of alcohol outlets through their zoning powers, but prohibits any other type of local ordinance that “directly or indirectly regulates ... or limits the operation” of a state license holder.²⁶ Pennsylvania law, by contrast, permits broad local zoning powers.²⁷

3. **Joint local–state licensing and regulatory powers.** In these states, alcohol retailers must obtain two licenses, one from the state and one from the municipality where they are located. In most cases, this gives the primary responsibility for determining alcohol availability to local governments, subject to minimum standards established by the state. In Georgia, for example, the state cannot issue a license until the applicant first receives a local license, and the state defers to local governments in most regulatory matters.²⁸ This may vary, however. Local licensing agencies exist in Louisiana, for example, but their powers are limited by state law.²⁹

4. **Exclusive local licensing, with minimum state standards.** The remaining states delegate the licensing authority entirely to local government and do not issue state licenses at all. Instead, the state imposes regulations that local governments must honor. Minnesota and Maryland are two such states, which allow municipally owned stores to operate.³⁰

These categories should not mask the variation among the states and the complexity of the state–local delegation issue. For example, many states in the second category have statutes that appear to give the state exclusive licensing and regulatory authority. Further research reveals additional statutory provisions or decisions by state courts that permit exceptions to the general rule.³¹ Even Minnesota, with exclusive local licensing, has preempted local authority to some degree. For example, municipalities in that state cannot restrict 18- to 20-year-olds from working at retail alcohol outlets.³²

The complexity arises in part from the ambiguity inherent in the state preemption doctrine. Legal treatises and courts have defined two types of preemption, express and implied. Express preemption occurs when the state law asserts its intent to occupy a given field of regulation. Implied preemption arises when a state regulatory scheme is so extensive that no room remains for local regulation.³³

This is logical in principle but confusing in application. For example, most states specify the maximum hours of alcohol retail operation. Can cities require an earlier closing time? Courts in some states have held that there is express preemption because the legislature has evidenced an intent to occupy the regulation of hours of sale; courts in other states have concluded that this is implied preemption because the regulation is part of a comprehensive regulatory scheme. In yet a third interpretation, courts have concluded that local ordinances imposing stricter closing times are permissible because the state legislature merely set minimum standards.³⁴

Several state court cases offer similar examples of the ambiguity inherent in the preemption doctrine. The Texas Supreme Court overruled a lower court and held that a state law placing exclusive regulatory authority in the state ABC agency preempted a Dallas ordinance designed to reduce the density of alcohol outlets in an inner-city community.³⁵ Courts in California, by contrast, held that a similar state provision did not preempt an Oakland ordinance reducing retail availability in its inner-city neighborhoods because the ordinance had only an indirect impact on alcohol sales.³⁶

Only one aspect of the preemption doctrine seems relatively straightforward. Local governments cannot permit activities that state law expressly prohibits. Thus, a local government may not permit a bar to remain open during hours that the state disallows without explicit permission from the state legislature. This foundational legal principle provides a potential basis for an effective division between state and local powers. States can be responsible for establishing minimum alcohol availability regulatory standards applicable to all communities in their jurisdiction. Local governments cannot override these minimum requirements, but can be given the flexibility to create additional, more restrictive, standards that respond to local needs and circumstances.

In most states, local regulatory authority, if it exists, is limited to retail availability. In general, states are reluctant to allow localities to tax alcohol or to permit regulation of the production or wholesale tiers of the industry. There are exceptions to this rule, as some states allow local taxation in certain circumstances. More common are locally imposed fees on alcohol retail outlets. Local marketing restrictions, if allowed, are usually limited to point-of-purchase or outdoor advertising.

As this review suggests, there is a complex division of regulatory authority between states and local governments which varies widely among the states. Because of the ambiguities involved in applying the state preemption doctrine, the lines of authority may be uncertain, requiring court interpretation. This creates significant problems for researchers seeking to generalize this topic across jurisdictions, an important component of many alcohol policy studies.

Branches of Government and Types of Law³⁷

A fundamental aspect of U.S. law involves the three branches of government: legislative, executive–administrative, and judicial. The separation of powers across the three branches of the federal government is a foundational principal of the U.S. Constitution, which is mirrored at the state and local governmental levels. The legislative branches enacts the laws (statutory law), the executive or administrative branch implements the laws (administrative law), and the judicial branch interprets them (judicial law). Although simple in concept, these three types of law overlap, with uncertain boundaries that can change over time and across topics. They also have a complex interaction, making it difficult to determine the variables of a particular policy in one jurisdiction and to compare the policy variables across jurisdictions.

Statutory Law

The U.S. Congress, the state legislatures, and local city and county legislative bodies (e.g., city councils) enact laws, that usually, but not always, initiate the development of a particular alcohol policy. The laws are enacted through specific legislative bills (enacted bills), which can either create new law or amend existing law. The enacted bills form the basis for codified laws, which organize enacted bills by subject matter.

The process of enacting bills creates a complex codified law over time. State ABC Codes (the codified law applicable to the alcohol trade) provide a classic example of this process. Most of these codes date back to Repeal and retain the basic structure developed seven decades ago. Over these 70 years, hundreds or thousands of bills have been enacted, creating new sections and amending old ones. The process is piecemeal. There may be dozens of sections addressing the same policy variable, with exceptions and exceptions to the exceptions found in various parts of the code. ABC Codes are especially susceptible to this process because they are prime targets of special interest legislation—laws designed to advance the interests of a particular constituency. Minor exceptions to tied house laws, for example, can be sprinkled across the code in a crazy quilt that takes extensive research to understand.

A key function of legal research is to assess the impact of proposed and newly enacted bills. This requires an examination of statutory codes, a complex process because a single enacted bill can affect multiple codified statutes. The interaction of enacted bills and codified statutes is important in conducting historical legal research and can be enormously complex. A single statute may have been modified over time by dozens of enacted bills. Each of these bills must be examined to determine what aspect of the codified law was amended.

Administrative Law

Federal, state, and local government executive or administrative agencies are responsible for implementing the laws enacted by their respective legislative branches. The agencies establish administrative rules and regulations to guide the implementation process, with the extent of the agencies' discretion and authority established by the legislative branch through provisions that are specific to a given law and laws that provide general implementation guidelines.

Regulations constitute the most formal form of administrative law. They are usually enacted after a legislatively established review and comment process, are entered into registers or other record form, and usually codified by topic. Agencies may use less formal rules or directives to guide policy implementation. In some cases, directives can be internal documents that address the application of a law in specific circumstances and not meant to provide general guidance to those affected by the law. Administrative agencies may have review processes to resolve conflicts arising from the application of administrative regulations. The resulting administrative decisions constitute an additional element of administrative law. In general, the regulations, rules, directives, and administrative decisions are not well maintained from the point of view of researchers. Historical records are often nonexistent, registers may be difficult to search, and less formal directives may not be available except by request.

The importance of administrative law to defining a given alcohol policy will vary by policy. In some cases, it has a relatively minor role, for example in alcohol tax policy. The tax is established by the legislature, and the tax agency charged with collecting it may have rules and regulation for its collection, but it has no discretion to change the legislative tax rate. Responsible Beverage Service (RBS) policies, on the other hand, are often highly dependent on regulations. In Arizona, for example, RBS programs "may" be mandated by the Arizona Department of Licensing and Liquor Control (ADLLC), providing broad discretion to the administrative agency.³⁸ In response, ADLLC has mandated such programs for managers of all retail outlets, made it discretionary for other staff, licensed RBS training programs, and mandated the training for staff of any retail licensee that is in violation of sales to minors laws.³⁹

Although clear in concept, the distinction between administrative and legislative law is blurred in application. Administrative agencies frequently exercise broad discretion to interpret or reinterpret laws, even when the provisions are apparently straight forward. An agency may decide not to implement a law because it determines it is not enforceable, too expensive, or possibly in violation of other laws or a state or the U.S. Constitution. Its interpretation of a law may directly conflict with the statutory language.

State ABC agency interpretation of state laws defining and taxing flavored alcoholic beverages (FABs, also termed "alcopops") offers a case in point.⁴⁰ These beverages are produced by stripping beer of its taste, color, and much of its alcohol and then adding flavorings that contain distilled spirits.⁴¹ The U.S. Tax and Trade Bureau [the successor to the Bureau of Alcohol, Tobacco, and Firearms (BATF)] determined after an extended rule making process that the end product could be classified as beer if less than half the alcohol is derived from distilled spirits.⁴² This 2005 decision came 9 years after a preliminary decision, never enforced, concluded that any beer that contained added distilled spirits should be classified as distilled spirits under federal law and subject to distilled spirits taxes.⁴³

BATF acknowledged that its regulatory decision regarding the definition of beer was in conflict with many state laws.⁴⁴ An independent legal analysis concluded that FABs should be classified as distilled spirits in at least 29 states.⁴⁵ Yet only two state agencies responsible for

implementing state laws regarding the classification of alcoholic beverages have taken action to reclassify FABs as distilled spirits.⁴⁶

Case Law

The judicial branch of government is responsible for interpreting state and federal Constitutions and laws and resolving conflicts that arise in their implementation. Federal courts interpret federal law, and state courts interpret state and local laws. Each system has its own hierarchy of appellate courts to review lower or trial court decisions. The opinions issued by these courts are known as decisions, or cases, and are collectively referred to as case law.

Courts only review a particular law when a party (a public agency, private organization, or individual) files legal papers requesting their review of a particular conflict. Most cases start at the trial court level, and parties may appeal decisions in the lower courts to appellate courts, ultimately reaching the state Supreme Court (for state and local law issues), or the U.S. Supreme Court (for federal claims).

Incorporating court decisions into the analysis of a given alcohol policy is complicated by two fundamental principles of the judicial process. First, courts generally do not issue advisory decisions. Instead they resolve conflicts in the context of specific factual disputes. The art of lawyering largely involves the ability to distinguish one set of facts from another, convincing courts to either apply or ignore previous court decisions depending on the interests of the lawyer's client. Case law thus focuses on the particular. An interpretation of a law or policy is only definitive as to the underlying set of facts that brought the issue to the court in the first place.

Second, only the Supreme Courts of the states and the federal government can issue definitive rulings applicable to the state or the United States as a whole. Supreme Court decisions are relatively rare and often resolve conflicting decisions in the lower courts. Trial court decisions apply only to the district in which it sits. The opinions of state trial courts are considered of such little consequence that they are not routinely reported or relied upon. Intermediate appellate courts, the primary source of judicial law, have jurisdiction over only a portion of their state or federal region and their decisions need not be followed in other districts unless mandated by a higher court. Their opinions may conflict with each other, yet in most cases they constitute the only source of judicial interpretation of a given statute. Adding to the problem, court cases are expensive, so a questionable decision may not be challenged either on appeal or in another appellate district.

This can be a serious problem in conducting legal alcohol policy research. There is no definitive measure of the weight to be given to appellate, non-Supreme Court decisions even though their impact may play a critical role in particular alcohol policies. For example, the City of Oakland, California, implemented an ordinance that placed a fee on retailers that funded enforcement of public nuisance standards imposed on the retailers' businesses. The retailers argued before the state Appellate Court that the ordinance was preempted by state law. The city won the case in an opinion that restricted the state preemption doctrine, and the Supreme Court refused to review. As a practical matter, the court decision constituted new law in the state and prompted several other cities to adopt similar ordinances. Yet its impact could not be determined for years, to see if other cases would be brought in other districts that might reach contrary results.⁴⁷

Adding to its complexity, courts may also decide to impose new standards of conduct on particular parties in what, in practice, constitute new laws. This can be accomplished through the application of common law principles that derive from a body of case law that should be applied in the absence of clear legislative direction. Dram shop liability illustrates this judicial power. Until the mid-1970s, courts concluded that alcohol retailers could not be held liable for the damages of those injured by their underage or intoxicated patrons without clear legislative directive. A series of court decisions in several states started applying a new rule: such liability was permitted under common law unless otherwise provided by the state legislature. These initial decisions led to a sweeping change in dram shop law in the United States, which is now based on both legislative and case law.⁴⁸

CONCLUSION: IMPLICATIONS FOR ALCOHOL POLICY RESEARCH

Legal analysis is a critical and complex aspect of alcohol policy research. Formal alcohol policies rest on legal enactments by legislatures at all levels of government, as implemented by administrative agencies and interpreted by the judicial system. Yet, as this brief review suggests, legal researchers encounter enormous barriers when attempting to define the variables of a specific alcohol policy at any level of government. Ambiguities, overlaps, and complex interactions occur throughout the legal system that makes definitive conclusions difficult or impossible.

This stems in part from the nature of our legal system, which operates in a unique manner that complicates the integration of legal and social science research traditions. Lawyers are trained to disaggregate legal data—to place primary emphasis in their research on the specific applications of laws. This approach is encouraged, indeed required, by judicial law, which is the final arbiter regarding the interpretation of statutory and administrative law and operates primarily in the context of factual disputes. A good lawyer is able to develop new interpretations of laws, show that an application in one circumstance is or is not appropriate in another. The research almost always moves from the conceptual to the specific. A policy cannot be understood except in the context of a factual situation.

The complexity and barriers, while significant, are not insurmountable. The challenge is to develop methodologies and conceptual frameworks for addressing them. Significant progress is being made in this regard in the Alcohol Policy Information System (APIS), funded by the National Institute on Alcohol Abuse and Alcoholism. APIS is now in its fifth year. It is an online resource that provides detailed information on various alcohol-related policies, focusing on state and federal statutory and regulatory laws. Designed primarily as a tool for researchers, APIS simplifies the process of ascertaining the state of the law for studies on the effects and effectiveness of alcohol-related policies.

APIS has developed detailed protocols for conducting statutory and regulatory research and integrated social science and legal research traditions. This has required extensive training of the legal research staff in social science concepts and methodologies and social science staff in legal research. The researchers in the two research traditions engage in an iterative process to develop policy variables and classifying statutory and regulatory provisions. The research attorneys specialize in challenging the social science variables, identifying exceptions and complications found in the law. The social scientists, in response, gain a deeper understanding of

the policies, developing more robust and accurate variable definitions that can be applied across jurisdictions.

APIS represents a significant advance for the alcohol policy field and establishes legal alcohol policy research as a legitimate field of study. Yet this new tradition remains in its infancy. Because of the difficulty in conducting historical legal research (as described above), APIS data sets remain relatively short. Prospective legal research is needed to provide the historical data useful to many social science research methodologies. APIS focuses primarily on state and federal legislation law, avoiding local and judicial law, in part because it is a feasible first step into the legal system thicket. As the system matures, it needs to develop methodologies for integrating these other dimensions of the legal system. Continued advances in the legal alcohol policy field will provide an invaluable tool for social science researchers, policy makers, and community activists seeking to advance the alcohol policy prevention field.

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Alcohol Regulation in Sweden and the European Union *Effects on Road Safety*

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Various restrictions regarding the use and availability of alcohol have been in use almost as long as man has been drinking alcohol. There are records of regulations regarding the production, distribution, and consumption of alcohol in ancient Greece, Mesopotamia, Egypt, and Rome (Ghalioungui, 1979). Often the main true reasons for the regulations were not concerns about public health but rather a means for the state to collect revenue.

Over the years, the threat to public health has been considered so severe that extreme measures like total prohibition have been employed. However, even such radical measures failed and created other problems.

In general, there are five groups of alcohol policies and regulations: policies that reduce drinking and driving; policies that support education, communication, training, and public awareness; policies that regulate the alcohol market; policies that support the reduction of harm in drinking and surrounding environments; and policies that support interventions for individuals with hazardous and harmful alcohol consumption and alcohol dependence.

Certain preventative measures have proven themselves to be efficient in reducing the harmful societal effects of alcohol consumption.

These countermeasures range from prohibition to warning labels and they all have varying levels of efficiency and cost effectiveness.

The drinking–driving field is one the great public health stories—at least according to the very comprehensive review, *Alcohol*—no ordinary commodity which was written by 15 of the world’s leading experts, one of which is present here. The conclusion is even drawn that countermeasures applied to reduce drinking–driving are also effective in reducing the total burden of alcohol related harm. The mechanism behind the success being that strict regulations and enforcement in the road traffic scene forces people to drink less. It is a well-established fact that fatal accident rates increase with increased per capita consumption in many European countries. There is ample testimony to the effectiveness of interventions like reductions of the legal blood alcohol content (BAC) limits in reducing traffic crashes (Mann et al., 2001).

Unfortunately, it is not entirely true that it is a success everywhere and the degree of success tends to vary over time.

A plethora of countermeasures have been employed in order to reduce the toll taken or at least contributed to by alcohol in traffic. These countermeasures have been applied to various degrees and with great variations in the time table in different countries. Norway introduced a BAC limit as early as 1937 and the last six countries to legislate per se limits in Europe did so in the late 1970s.

EUROPE AND ALCOHOL

In order to be able to understand why we see the great variations across borders and cultures we need to look at the diversity of the European scene. We need to remember that there are as many

as 450 million Europeans and they speak some 20 different languages. We also need to look at how alcohol is produced and used in Europe.

Europe produces some 70% of all wine in the world. Europeans drink more alcohol than people anywhere else in the world. But even within Europe there are vast differences in levels of consumption, in the preferred beverages, where alcohol is consumed, and how often.

Also, great changes are taking place. There is a strong tendency for countries where distilled spirits traditionally were the preferred beverage to drink wine and beer and for wine countries to go from wine to beer and, especially among young adults, to distilled spirits. Traditionally, binge drinking once a week to get drunk has been the norm in what sometimes has been labeled the Vodka Belt, which consists of the northern part of the Northern Hemisphere. This has been replaced to some extent, or at least combined with drinking more often but in lesser amounts and more often wine or beer.

For decades it was always said that you would never see someone drunk, at least not in public, in the wine countries whereas it was quite common in the Vodka Belt. Now drinking habits seem to converge and almost 20% of German youngsters between 12 and 17 years of age have been drinking to unconsciousness during the last month. There are now even new terminologies for this phenomenon, e.g., “komasaufen” which is German and means drink to coma or “el botellon” in Spain, or “strage del sabato sera” in Italy. In many European countries the mean age for the first alcoholic drink is as low as 11.8 years (DN, 11/3)

Table 1 describes the minimum age for purchase of different types of alcoholic beverages on and off premise, respectively. As can be seen, a few countries deviate considerably from the general 16 to 18 years of age.

We can also see that total alcohol consumption is converging. Traditional wine countries like France and Spain with very high total consumption have reduced their consumption rather dramatically and vice versa for rather low total consumption countries like Finland, Norway, and Sweden (Babor et al., 2003).

Many of the observed changes have not occurred as a result of changes in regulations but rather as a result of increased intercultural exchange or other informal influences. One example may be the ongoing debate about the harmful or beneficial health effects of alcohol consumption. This has been particularly prominent regarding the claims of reduced incidence of ischemic heart disease following a regular intake of the equivalent of one to two glasses of wine per day. It goes without saying that society as well as individuals suffer when it comes to excessive alcohol consumption. More violent crime, accidents, and sickness appear in the traces of increasing consumption figures.

Relationship Between Total Alcohol Consumption and Road Safety

Norström (1997) has described the relationship between the total consumption of alcohol and drunk driving. He finds that an increase of 1% results in an increase of drinking-driving by 0.6%. An increase of consumption by 1 L of pure alcohol per inhabitant older than 15 results in 11% increase of drunk driving and 8% increase of fatalities in traffic.

The relationship between harm and increased total consumption may change over time if drinking habits change. For instance, harm may increase less than what an increase in alcohol consumption suggests if the increase is distributed more evenly than previously, i.e., if the

TABLE 1 Minimum Age for Purchase of Alcoholic Beverages On and Off Premises

<i>B = Beer</i>	Min. Legal Age					Min. Legal Age			
	On-premise		Off-premise			On-premise		Off-premise	
	<i>B&W</i>	<i>S</i>	<i>B&W</i>	<i>S</i>		<i>B&W</i>	<i>S</i>	<i>B&W</i>	<i>S</i>
<i>W = Wine</i>									
<i>S = Spirits</i>									
Austria	16	16-18	16	16-18	Lithuania	18	18	18	18
Belgium	16	18	None	18	Luxembourg	16	16	None	None
Bulgaria	18	18	18	18	Malta	16	16	None	None
Czech Rep.	18	18	18	18	Netherlands	16	18	16	18
Denmark	18	18	16	16	Norway	18	20	18	20
Estonia	18	18	18	18	Poland	18	18	18	18
Finland	18	18	18	20	Portugal	16	16	16	16
France	16	18	16	16	Romania	18	18	18	18
Germany	16	18	16	18	Slovak Rep.	18	18	18	18
Greece	17	17	None	None	Slovenia	18	18	18	18
Hungary	18	18	18	18	Spain	16-18*	16-18*	16-18*	16-18*
Iceland	20	20	20	20	Sweden	18	18	20	20
Ireland	18	18	18	18	Switzerland	16	18	16	18
Italy	16	16	16	16	Turkey	18	18	18	18
Latvia	18	18	18	18	UK	18	18	18	18

* Minimum legal age in Spain is 18 in all but 4 regions. Source: Global Status Report on Alcohol Policy (WHO 2004) and updates from the Alcohol Policy Network co-financed by the European Commission.

increase takes place among the light drinkers. Correspondingly, harm will increase more than expected if heavy drinkers in particular add to their consumption. In principle, it is also possible that drinking habits become less harmful and less intoxication oriented if, for instance, drinking wine at meals replaces intoxication-oriented drinking (Mäkelä and Österberg, 2006). However, for the road traffic scene, even the latter scenario might be a threat to road safety in that it means a greater number of conflicts between drinking and the need to drive.

The World Health Organization (WHO) has set a global target of 25% reduction of alcohol consumption. This would lead to a 15% decrease of drinking–driving according to Norstrom's figures.

Development of Alcohol Consumption Levels in Europe

For most of Europe there seems to have been a decrease of consumption since the mid-1970s. The shining example is France where the greatest changes have taken place. The total consumption has gone from approximately 18 L of 100% alcohol per capita >15 years of age down to app 12 L. Wine with every meal is no longer the norm. Fewer people drink every day. But there is a tendency for more binge drinking.

Below (Figure 1) is a ranking of strictness of alcohol legislation in a number of European countries in 1950 and in 2000 (WHO). Grube and Stewart (2004) find that policies that regulate the alcohol market, including the price of alcohol, the location, density, and opening hours of

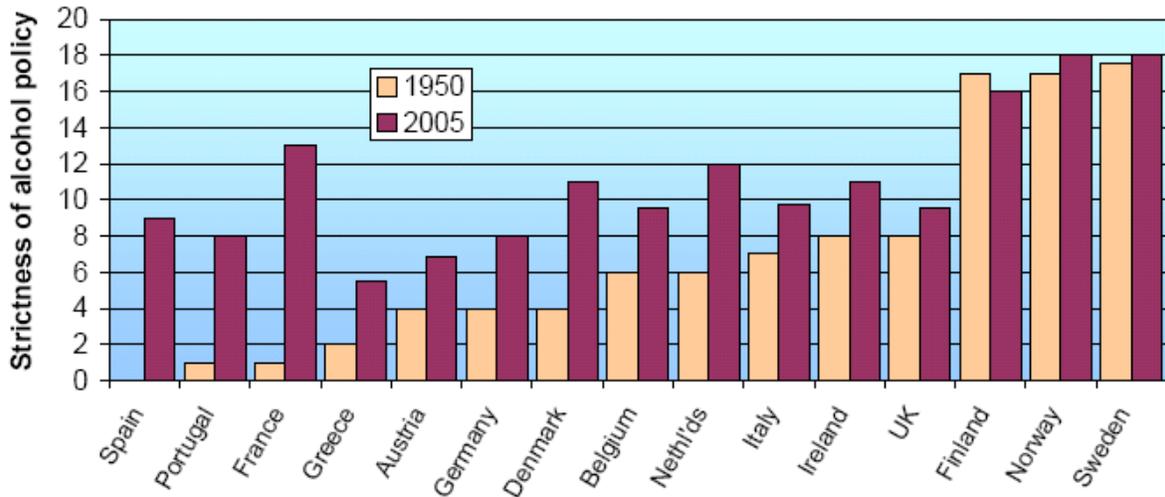


FIGURE 1 Ranking of strictness of alcohol legislation in a number of European countries in 1950 and in 2005.

sales outlets, controls on the availability of alcohol, and on the promotion and advertising of alcohol, have an impact in reducing drinking and driving and related fatalities.

As can be seen from the change between 1950 and 2005, there is a strong tendency towards convergence and this is also what the European Commission is striving for very explicitly.

The European arena has seen different trends within different alcohol policy areas over the time period 1950 to 2005 as is illustrated in the graph (Figure 2) below.

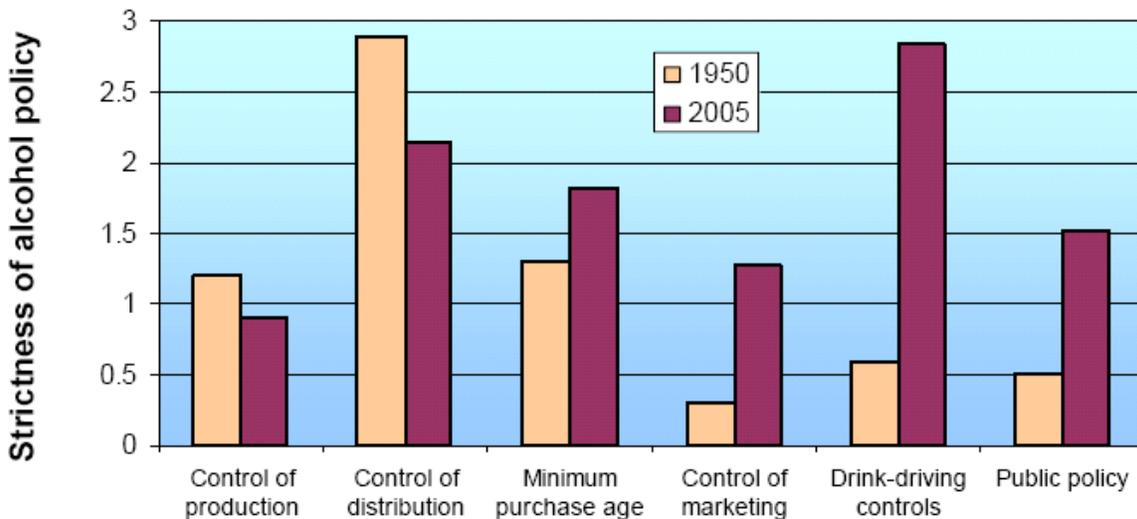


FIGURE 2 Different trends within different alcohol policy areas over the time period 1950–2005.

The previous two graphs (Figures 1 and 2) convey the message that there is a positive trend of alcohol policy for Europe but not for all individual nations.

There has been a strong push towards the same levels of taxation. To this end, minimum tax levels have been set. The European Union (EU) has not been able to change the minimum alcohol excise duty rates since their introduction in 1993, causing the value of alcohol excise duties to decrease in real terms by about one fourth. The problem, however, is that these minimum levels are extremely low and this creates vast differences between member states. Thus, the minimum level for wine has been set at 0. The reason for this lies in the fact that wine is considered to be an ordinary agricultural product which enjoys the subsidies which are extremely important for the producers.

In the graph (Figure 3) below we can see that there are vast differences in the taxation levels on beer and wine within Europe.

The same is true of taxation on 100% alcohol as is shown in Figure 4.

Taxation differences between nations may also be illustrated as the relative price of alcohol (Figure 5).

There are also differences among nations in the proportion of abstainers. Therefore it is possible to present a slightly different picture of the consumption of alcohol in Europe as in the graphs below (Figures 6 and 7). They show the proportion of abstainers and the consumption per drinker (graphs from Anderson and Baumberg, 2006).

If alcohol taxes were used to raise the price of alcohol in the EU by 10%, over 9,000 deaths would be prevented during the following year and around US\$16.5 billion of additional excise duty revenues would be gained (Anderson and Baumberg, 2006). In Finland, Sweden, and Norway where the effects of both price (on consumption) and consumption (on harm) are stronger, it is estimated that there would be a reduction of 6% to 7% in suicide deaths and accidents, together with a 20% decrease in directly alcohol-related deaths for men and a 40% decrease for women.

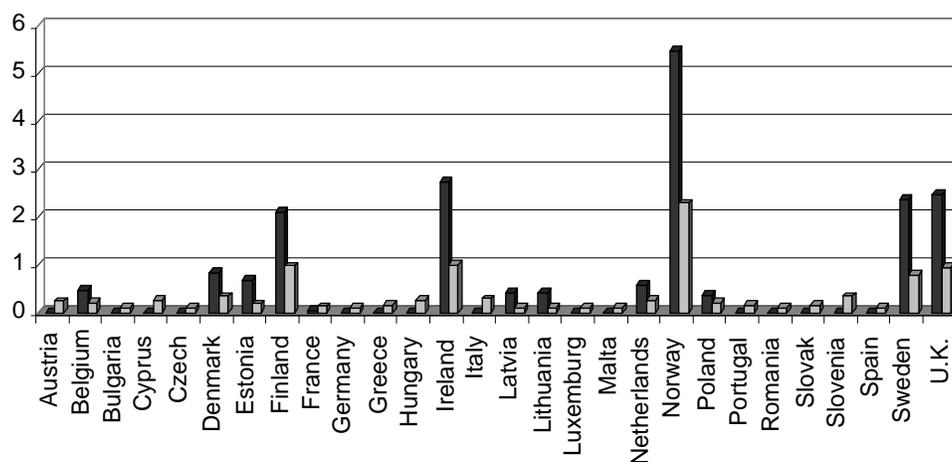


FIGURE 3 Differences in the taxation levels on beer and wine within Europe.

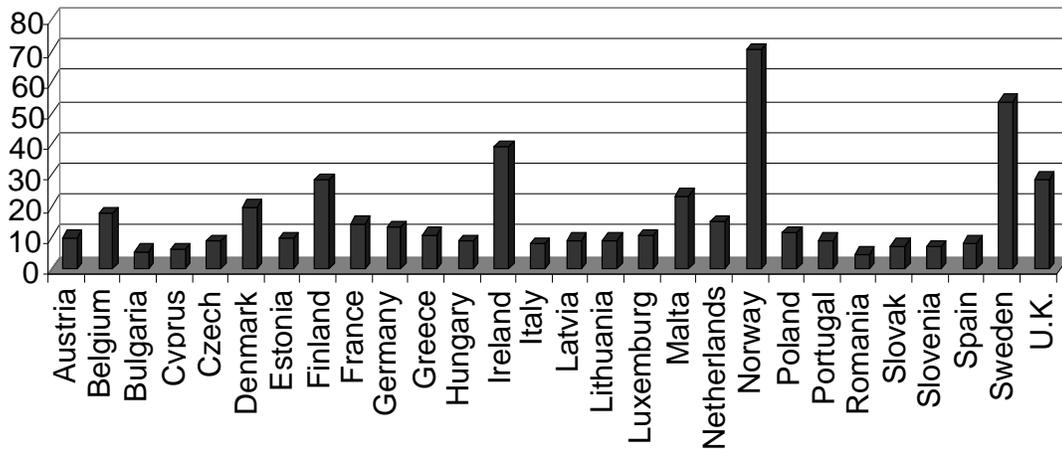


FIGURE 4 Differences in the taxation levels on 100% alcohol within Europe.

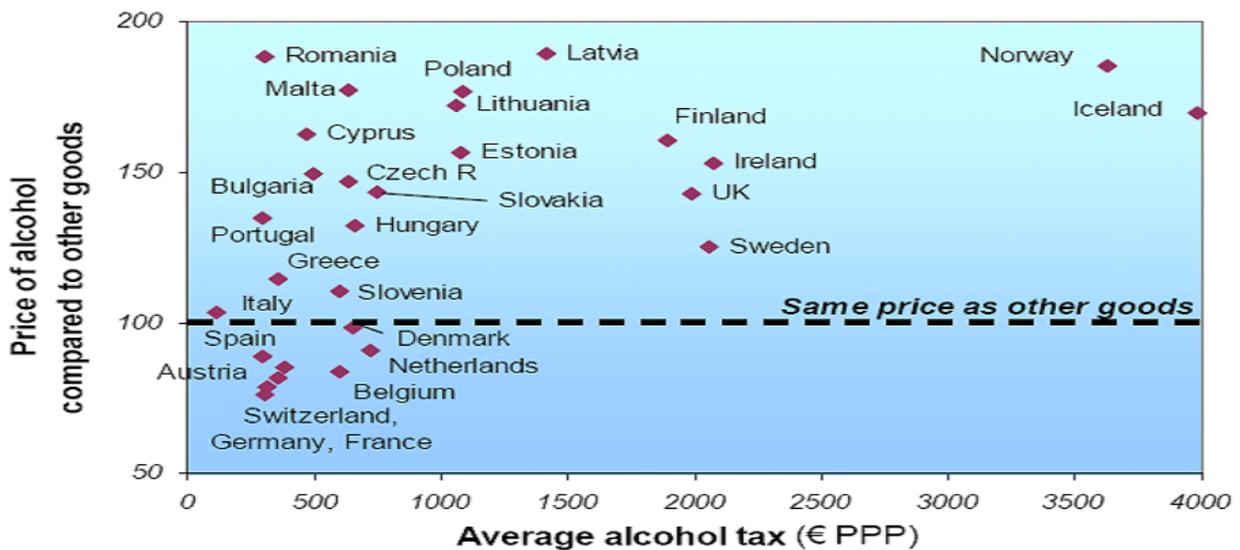


FIGURE 5 Relative price of alcohol compared to other goods.

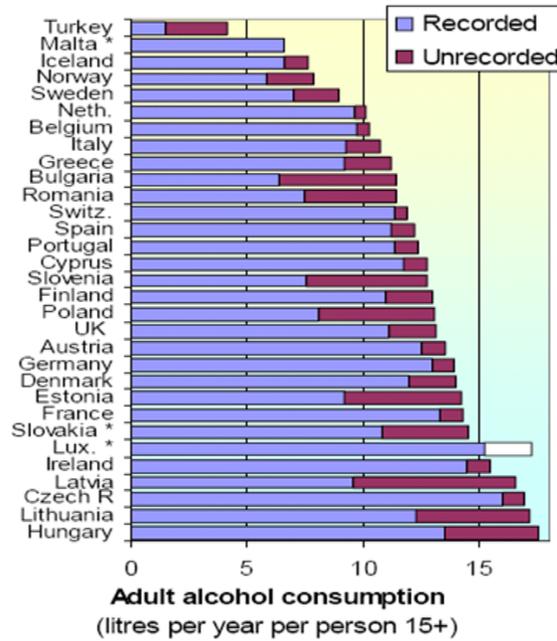


FIGURE 6 Alcohol consumption by adults in Europe.

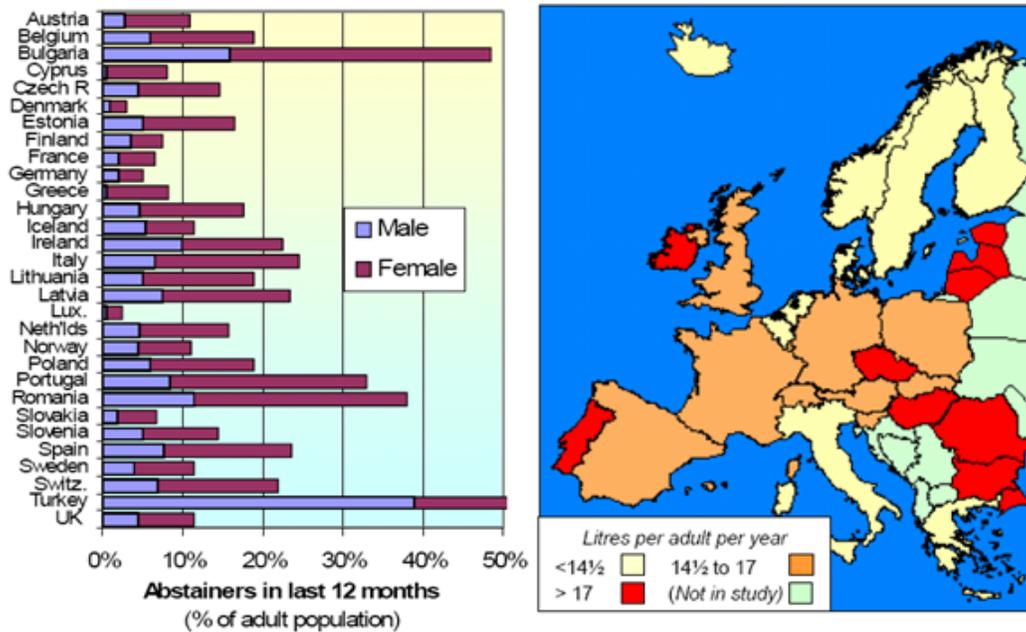


FIGURE 7 Alcohol consumption by adults in Europe, by gender.

With the creation of the single European market in 1993, quantitative quotas for travelers' alcohol imports were abandoned. Therefore, from January 1, 1993, travelers were allowed to bring alcoholic beverages bought legally in other member states for private consumption through customs without having to pay excise duty in their home country. As a consequence of this, Denmark lowered its beer and wine tax by 50% in 1991 and 1992 to try to cope with the border trade at the German borders.

The Nordic countries tried to negotiate exemptions and used the argument that public health would suffer if alcohol consumption increased. They were successful in that a timetable was set. In Sweden's case it meant that the maximum quantities of alcoholic beverages that could be bought in other EU member states and permitted to be imported into Sweden tax free increased from 1 L of distilled spirits and 1 L of wine or 2 L of wine, up to January 1, 1995, to unrestricted volumes for private use in 2004. The norm is 10 L of distilled spirits and 90 L of wine and 110 L of beer. (Few private cars have the capacity to carry more than the full allowed volume for two persons.) The price differences of alcoholic beverages, especially of beer, between Sweden, Denmark, and Germany combined with led to increases in travelers' alcohol import. Huge alcohol stores were established right next to the ferry docks in Germany. Bus companies arranged special trips to these alcohol stores with the single purpose of bringing home cheap alcohol. Ferry lines to the Baltic States with even lower alcohol prices blossomed. The islands of Åland, between Stockholm and Finland, are not formally a member of the EU and therefore the ferries between Stockholm and Helsinki made a detour just to touch on Åland in order to make it possible to buy real tax-free alcohol etc.

Partly because of the increase in border trade in beer, Sweden reduced its excise duty rate for beer in 1997 by 39% and in 2001 for wine by 20%.

In 2003, Denmark's exemption for import quotas for distilled spirits was abolished and this forced Denmark to lower its excise duty rates for distilled spirits by 45%. Similarly, Finland reduced its duty rate by 44% for distilled spirits and for wine by 10% and for beer by 32%. All of this put Sweden in an even tighter spot, knowing that increases in beer taxes can reduce youth motor vehicle fatalities (Saffer and Grossman, 1987*a,b*). Furthermore, Denmark lowered its excise duty rates for beer and wine by 13% in 2005. As an example: in 2004, a bottle of cheap vodka was about SEK\$200 in Sweden; about SEK\$110 in Denmark; about SEK\$70 in Germany and in Estonia about SEK\$65.

The Swedish Parliament is discussing whether Sweden should lower its alcohol taxation and the figure 40% has been suggested. The reaction from Denmark has been that if Sweden lowers its taxation, Denmark will lower its taxation correspondingly and Germany has reacted to this by stating that if Denmark lowers its taxation, Germany will also do so to maintain the difference—a race towards the bottom.

OTHER CONSEQUENCES OF SWEDEN'S MEMBERSHIP IN THE EU

Alcohol policy in Sweden and the other Nordic countries was for many decades based on social policy and public health considerations and included high excise duty rates on alcoholic beverages, comprehensive state alcohol monopoly systems for production, and trade and strict controls on alcohol availability (Karlsson and Österberg, 2001). When these countries became members of the EU, much of this was, in essence, lost. The retail sales monopolies were retained but under constant threat while the production and wholesale monopolies were lost. Availability

of alcohol was increased by expanding opening hours of the monopoly stores; the number of licensed restaurants and bars increased by several hundred percent; price as a weapon was weakened considerably; alcohol advertising restrictions became almost obsolete, etc. Saffer (1997) estimated that a total ban on alcohol advertising might reduce motor vehicle fatalities by as much as 5,000 to 10,000 lives per year in the United States.

Increased Consumption

All of the deregulation moves which have been forced upon Sweden have led to a tremendous increase of alcohol consumption in the Swedish society. In 1996, the total alcohol consumption level for persons older than 15 years of age was 8 L of pure alcohol per year. In 2004, this figure had risen to 10.5 L. Instead of the 25% decrease which was the WHO goal, Sweden was faced with an increase of more than 25%.

The effects of increased total consumption of alcohol in the Swedish society have reached a level where people are starting to react. Only 40% are now in favor of a lowering of alcohol taxation (DN 11/5). Temperance organizations, who for many decades have seen their membership being reduced and the age distribution moving towards the high end, are now welcoming thousands of new members.

Road Safety Consequences

It is extremely hard to find out what role alcohol has had in road safety and to make comparisons between countries. It is even very hard or impossible to find out what official statistical numbers actually represent in the various member states. Consequently, it is even harder to try to draw conclusions about the role of certain measures or regulations and to try to compare between nations.

Figure 8 illustrates the calculated costs incurred by alcohol in the EU (Anderson and Baumberg, 2006).

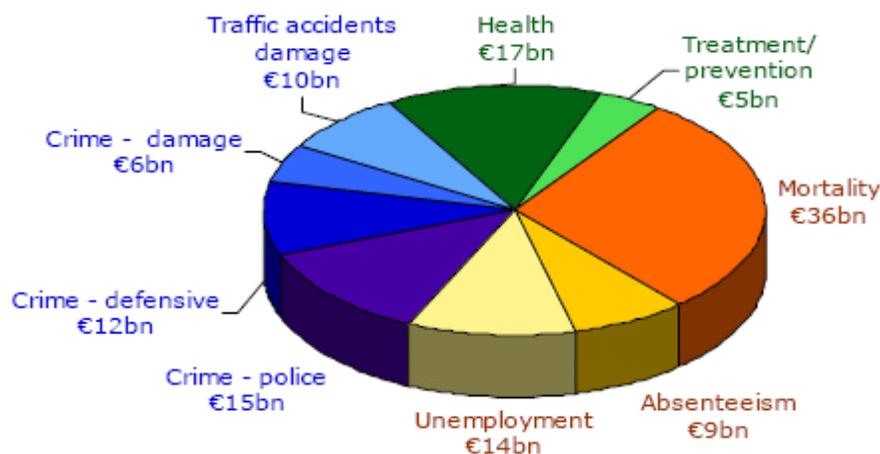


FIGURE 8 The calculated costs incurred by alcohol in the EU

The European Commission has been trying hard to obtain acceptance for a directive which would impose a maximum legal BAC limit of 0.05%. This has failed because of resistance from three member states with 0.08% limits. So, the Commission has presented a recommendation that a maximum level of 0.05% should be applied in the EU and that a limit of 0.02% should be applied for new drivers and for professional drivers. In the EU there is now a wide range of BAC limits. Three member states have a zero limit; three more have a limit of 0.02%; the majority have a limit of 0.05%; and, as mentioned above, a number of member states are still at 0.08%. So far, two member states have opted for a lower limit for novice and professional drivers.

It is interesting to see that two of the countries (Sweden and United Kingdom) that are competing for the top position as the safest in the world have very different approaches to the problem of drinking and driving. Sweden has chosen a BAC limit of 0.02% and United Kingdom 0.08%. Despite this difference, they are both at the very top of the rankings. A deeper analysis of this phenomenon should be undertaken.

We also know that road safety has improved considerably in France lately and we know that France has become much tougher on drunk driving. The French police are carrying out several million random breath tests each year. This has coincided with a lowering of the legal BAC limit and with the introduction of a point system in which loss of a certain number of points means loss of license. Drinking-driving carries a high degree of penalties in this system. Based on today's knowledge, it is not possible to separate out the contribution to the increased safety from these individual changes.

Enforcement

For legislation to be effective, enforcement is necessary. The level of enforcement of drunk driving legislation varies considerably among the EU member states. The European Commission has recommended that random breath testing (RBT) should be carried out in all member states. The recommendation also carries a quantitative level of at least one breath test per license holder per 3 years. It was not possible to make it into a binding directive since a number of member states still do not allow random breath testing. Actually, across 21 EU countries, nearly 30% of drivers believe they will never be breathalyzed. In the countries with random breath testing only 22% of drivers thought that they would never be checked, compared to more than double this figure (46%) in countries without RBT (Germany, Ireland, Italy, Poland, United Kingdom) (SARTRE project).

Losses of Alcohol Policy Elements: Sweden a Good/Bad Example

The graph in [Figure 9](#) illustrates the development of the proportion of fatally injured car drivers who were positive for alcohol, 1989 to 2004.

The graph is based on body fluid samples taken during the autopsy. (More than 90% of all fatalities in road traffic are autopsied. There are missing bars in the graph because of the fact that a much smaller proportion was autopsied.)

The proportion is positive alcohol cases in relationship to the total number of tested car drivers. If suicide was indicated, this case was excluded.

As can be seen in the graph, Sweden had a very favorable development until the mid-1990s. This was replaced by a reversed development which has reached the same high levels again.

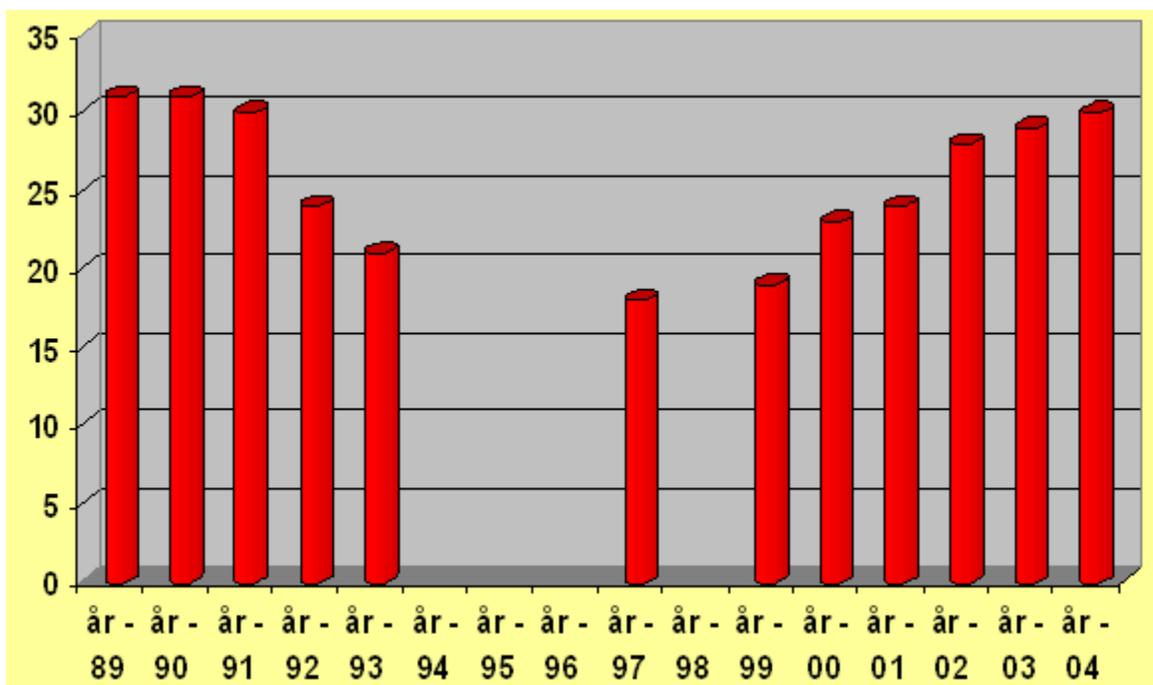


FIGURE 9 Development of the proportion of fatally injured car drivers who were positive for alcohol, 1989–2004.

Reasons for the Favorable Development in the Early 1990s

It is possible to identify a number of factors which may have contributed to the favorable development to various degrees. Firstly, on July 1, 1990, the legal BAC limit was lowered to 0.02% from the previous level of 0.05%. This step was evaluated by the Swedish Crime Prevention Council (Norström and Andersson, 1997) and they concluded that the lowering of the limit was associated with a 7% reduction of accidents overall, with an 11% reduction of single-vehicle accidents and with a 10% reduction of fatal accidents. However, the lowering of the limit coincided with a very deep recession in the Swedish economy, which reduced the proportion of young people who obtained their drivers licenses during the first year after having reached the license age by some 40%. This was also very favorable for road safety and this contribution may account for some 30% of the total effect of the lowering of the limit. Second, drinking-and-driving enforcement increased drastically and reached a peak in 1994. Third, the penalties for drinking driving were upgraded. Finally, resources for attitudinal work directed towards ages 15 to 24 were tripled.

Reasons for the Unfavorable Development in the Late 1990s and Until Now

The primary adverse factor is the major increase of alcohol consumption that has taken place in Sweden since the mid-1990s. When Sweden joined the EU in 1995, the per capita (>15 years of age) total consumption of alcohol was 8 L of pure alcohol per year. As of 2005, it had risen to 10.5 L—an increase of more than 30%. The increase was the result of increased availability of alcohol—almost totally opening borders to neighboring countries with much lower alcohol prices; many more alcohol outlets; longer opening hours.

Sweden also saw the advent of new alcoholic drinks of choice of young people.

The relationship between total alcohol consumption and drinking and driving has been studied by Norström (1997) who found that if consumption increases by 1 L, drinking and driving increases by 11% and fatal accidents by 8%. Since consumption has risen by 2.5 L, it is no wonder that the development of the proportion of alcohol-positive killed drivers is heading the wrong way.

Also, the drinking patterns changed from the traditional habits, typical of the Vodka Belt, namely to drink once a week to get drunk, into adding to the old habits more drinking occasions in the week but lesser amounts of alcohol. This, of course, means that there will be many more conflicts between drinking and the need for transportation.

A third reason is the fact that the enforcement again lost some 40% of its power almost immediately after having reached the peak level in 1994. It is now struggling to regain its position and actually has a target level for 2006 that is slightly higher than the previous peak level. The importance of enforcement in general and of RBT in particular is illustrated by results (Nilsson et al., 2001) indicating that an increase of the number of breath tests by 100,000 per year saves three to four lives.

The strong attitudinal campaigns, directed towards young road users, lost momentum since resources were reduced by 50%.

It can also be argued that the development was influenced by the fact that the courts became more lenient in their application of penal latitudes. The proportion of drivers who were sentenced to prison for gross drunken driving was reduced from 70% in the mid-1990s to less than 40% in the early years of the new millennium.

CONCLUSIONS

Regulations and policies, regarding alcohol in the EU member states, tend to converge and are pushed in this direction by the EU Commission. This means that a number of factors which may affect the drunk driving situation are improving in many member states. However, it also means that some member states may lose some of the tools to control alcohol availability which in its turn affects drunk driving.

It is not always a formal deregulation that causes the loss of control—it may be a difference in regulations between neighboring states which drives cross-border trade and forces the stricter state to deregulate. Since alcohol has such an important economic role in most European countries, this fact impedes the ability of countries to implement effective policies.

It is estimated that alcohol excise duties amounted to some US\$31.5 billion in the 15 countries in the EU. However, alcohol-attributable disease, injury, and violence is an economic burden to society in the health, welfare, employment, and criminal justice sectors with a total calculated tangible cost of approximately US\$158 billion in 2003. In addition to these costs there are, of course, intangible costs for pain, suffering, and lost life. In 2003, these were estimated to be US\$340 billion.

It is very unfortunate that this negative balance is not experienced in one and the same wallet.

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Alcohol Policies in the Americas

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Alcohol policies can be effective in changing alcohol consumption in the overall population as well as specific harms related to alcohol. Harms differ according to the amount and pattern of drinking (Rehm et al., 2003), and therefore information on the impact of alcohol in the disease burden is helpful to better appreciate the picture regarding alcohol policies.

Alcohol consumption, as measured by per capita consumption, is varied in countries of the region. **Table 1** presents estimates for the year 2000 for selected countries in the region. However, these figures reflect only recorded consumption and apparently there is a great deal of unrecorded consumption, ranging from 11% to 55% of the total figures.

The pattern of alcohol consumption, however, is more homogeneous. Although many countries have not undertaken appropriate general population surveys on alcohol consumption and patterns of drinking, key informants have provided information to the World Health Organization (WHO) that have been used to estimate the typical pattern of drinking in a country. **Tables 1** and **2** show that for the vast majority of countries the average pattern is more hazardous than the global average—characterized by infrequent, in high amounts per occasion, mainly for the purpose of intoxication.

Consumption relates to harm and information on the extent of harm is needed in order to develop and evaluate policies to reduce such harm. The latest estimates of the burden of disease in the region, as measured by DALYs (disability adjusted life years) are shown in **Table 4**. It can be seen that alcohol use disorders (mainly alcohol dependence), and injuries (intentional and unintentional) are the major sources of years of life lost due to excessive alcohol consumption. Alcohol is the leading risk factor for the burden of disease in the Americas, being greater than tobacco or lack of sanitation or malnutrition (Rehm et al., 2005), as can be seen in **Table 5**.

If nothing is done, it is predicted that the burden will increase in years to come, as alcohol consumption is likely to increase in the context of a hazardous pattern of drinking (Rehm and Monteiro, 2005). Therefore, information on existing alcohol policies in the region of the Americas is needed so consideration can be given to what needs to change and how, and will be focus of this paper.

METHODS

There are 35 countries in the region, of which information on national alcohol policies is available for the following 25: Argentina, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, United States, Uruguay, and Venezuela.

TABLE 1 Alcohol Exposure and Economic Characteristics of Selected Countries in the Americas, 2000

Country (WHO Classification)	Per Capita Consumption ¹	Unrecorded Consumption ²	Drinking Patterns ³	% Abstainers		Per Capita Consumption per Drinker ⁴	Per Capita GDP \$ ⁵	PPP per Capita GDP IS ⁶	Population 15 Years and Older in 1000s
				Males	Females				
Argentina (B)	16.3	1.0	2	7	21	19.0	7,460	10,980	26,767
Barbados (B)	7.4	-0.5	2	29	70	14.8	9,250	15,110	214
Belize (B)	6.4	2.0	4	24	44	9.7	3,110	5,150	145
Bolivia (D)	5.7	3.0	3	24	45	8.7	990	2,240	5,029
Brazil (B)	8.6	3.0	3	13	31	11.1	3,580	7,070	121,039
Canada (A)	9.4	1.0	2	17	28	12.1	21,130	26,530	25,248
Chile (B)	8.3	1.0	3	31	47	13.6	4,590	8,840	10,883
Colombia (B)	8.3	2.0	3	31	47	13.6	2,020	6,790	28,471
Costa Rica (B)	6.7	2.0	3	45	70	15.9	3,810	9,260	2,721
Cuba (A)	5.7	2.0	2	29	70	11.4	2,995	-	8,823
Dominican Republic (B)	5.7	1.0	2	12	35	7.5	2,130	6,650	5,688
Ecuador (D)	5.5	3.7	3	41	67	12.0	1,210	2,960	8,368
El Salvador (B)	4.6	2.0	4	9	38	6.0	2,000	5,160	4,042
Guatemala (D)	3.7	2.0	4	49	84	11.2	1,680	4,380	6,420
Guyana (B)	12.1	2.0	3	20	40	17.3	860	4,280	604
Haiti (D)	5.4	0.0	2	58	62	13.5	510	1,870	4,875
Honduras (B)	4.2	2.0	4	9	38	5.5	860	2,760	3,784
Jamaica (B)	4.3	1.0	2	29	70	8.6	2,610	3,490	1,781
Mexico (B)	8.2	4.0	4	36	65	16.7	5,070	8,240	66,105
Nicaragua (D)	3.7	1.0	4	9	38	4.9	400	-	2,905
Paraguay (B)	9.6	1.5	3	9	33	12.2	1,440	5,180	3,324
Peru (D)	5.4	1.0	3	17	24	6.8	2,080	4,470	17,094
Suriname (B)	6.0	0.0	3	30	55	10.5	1,890	-	290
Trinidad and Tobago (B)	2.4	0.0	2	29	70	4.8	4,930	8,620	971
USA (A)	9.5	1.0	2	28	43	14.8	34,280	34,280	218,586

(continued)

TABLE 1 (continued) Alcohol Exposure and Economic Characteristics of Selected Countries in the Americas, 2000

Country (WHO Classification)	Per Capita Consumption ¹	Unrecorded Consumption ²	Drinking Patterns ³	% Abstainers		Per Capita Consumption per Drinker ⁴	Per Capita GDP \$ ⁵	PPP per Capita GDP IS ⁶	Population 15 Years and Older in 1000s
				Males	Females				
Uruguay (B)	9.5	2.0	3	25	43	14.4	6,000	8,250	2,510
Venezuela (B)	9.6	2.0	3	30	55	16.8	4,310	5,590	15,943

¹ In litres of pure alcohol including unrecorded consumption.

² In litres of pure alcohol.

³ Hazardous drinking score with 1 = least and 4 = most detrimental (see text for further explanation).

⁴ Per capita consumption per drinker in litres of pure alcohol including unrecorded consumption.

⁵ Gross domestic product in U.S. dollars.

⁶ Purchasing power parity (PPP) in international dollars.

Source: Rehm and Monteiro, 2005.

TABLE 2 Characteristics of Adult Alcohol Consumption in Different Regions of the Americas 2000 (Population Weighted Averages Across Countries)

WHO Region (Definition see above)	Beverage Type Mostly Consumed	Total Consumption ¹	% Unrecorded of Total ²	% Heavy Drinkers ³	% Drinkers Among Males	Drinkers Among Females	Consumption per Drinker ⁴	Average Drinking Pattern ⁵
Americas A (Canada, Cuba, United States)	>50% of consumption is beer, about 25% spirits	9.3	11	11.2	73	58	14.3	2.0
Americas B (Brazil, Mexico; see above)	Beer, followed by spirits	9.0	30	9.1	75	53	14.1	3.1
Americas D (Bolivia, Peru; see above)	Spirits, followed by beer	5.1	34	2.7	74	60	7.6	3.1
World	Spirits	5.8	40	5.1	60	32	12.3	2.5

¹ Estimated total alcohol consumption per resident aged 15 and older in litres of absolute alcohol (recorded and unrecorded).

² Percentage of total adult per capita consumption (= column 3) which is estimated to be unrecorded.

³ Estimated % rate of heavy drinking (males ≥ 40 g and females ≥ 20 g) among those aged 15+.

⁴ Estimated total alcohol consumption (in litres of absolute alcohol) per adult drinker aged 15+.

⁵ Estimated average pattern of drinking (1–4 with 4 being the most detrimental pattern).

TABLE 3 Classification of Countries in the Americas by Childhood and Adult Mortality (6)

Americas A	Americas B	Americas D
Very low childhood and very low adult mortality	Low high childhood and low adult mortality	High childhood and high adult mortality
Canada, Cuba, United States of America	Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guyana, Honduras, Jamaica, Mexico, Panama, Paraguay, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela	Bolivia, Ecuador, Guatemala, Haiti, Nicaragua, Peru

Note: Definition of regions: the regional subgroupings used were defined by WHO (World Health Report, 2000) on the basis of high, medium, or low levels of adult and infant mortality.

TABLE 4 Alcohol-Related Disease Burden in DALYs (1000s) by Disease Category and Region

Region	The Americas**							World			
	A		B		D		A, B, and D				% all alcohol attributable DALYs
WHO classification	F	M	F	M	F	M	Total	Total	F	M	Total
Sex*											
Maternal and perinatal conditions	1	1	12	15	1	1	31	0.2%	55	68	123
Cancer	79	99	81	116	13	12	400	2.9%	1021	3180	4201

(continued)

TABLE 4 (continued) Alcohol-Related Disease Burden in DALYs (1000s) by Disease Category and Region

Region	The Americas**							World			
	A		B		D		A, B, and D				% all alcohol attributable DALYs
WHO classification	F	M	F	M	F	M	Total	Total	F	M	Total
Neuropsychiatric conditions	682	2113	792	2979	82	305	6953	50.1%	3814	18090	21904
Vascular conditions	-256	-174	162	480	16	38	266	1.9%	-428	4411	3983
Other non communicable diseases	25	165	101	531	20	55	897	6.5%	860	3695	4555
Unintentional injury	119	498	177	1815	29	268	2906	20.9%	2487	14008	16495
Intentional injury	53	222	118	1919	9	110	2431	17.5%	1117	5945	7062
All alcohol attributable DALYs	702	2925	1443	7854	170	789	13883	100.0%	8926	49397	58323
% alcohol attributable of all DALYs	3.2	11.9	4.1	17.3	2.2	8.6	9.7		1.3	6.5	4.0

* M = male, F = female.

** See Table 3.

Numbers are rounded to full thousands. E.g., 0 indicates that there are less than 500 alcohol-attributable DALYs in the respective category.

Source: Rehm and Monteiro, 2005.

TABLE 5 Leading Risk Factors for Disease Burden in the Different Regions of the Americas Defined by Adult and Child Mortality in Percent of Overall DALYs

Americas D		Americas B		Americas A	
Total DALYs in 1000s	17,052	Total DALYs in 1000s	80,437	Total DALYs in 1000s	46,284
Alcohol	5.5	Alcohol	11.4	Tobacco	13.3
Underweight	5.3	Overweight	4.2	Alcohol	7.8
Unsafe sex	4.8	Blood pressure	4.0	Overweight	7.5
Unsafe water & sanitation	4.3	Tobacco	3.7	Blood pressure	6.0
Overweight	2.4	Cholesterol	2.3	Cholesterol	5.3
Blood pressure	2.2	Unsafe sex	2.1	Low fruit and vegetable intake	2.9
Iron deficiency	1.9	Lead exposure	2.1	Physical inactivity	2.7
Indoor smoke	1.9	Low fruit and vegetable intake	1.8	Illicit drugs	2.6
Cholesterol	1.1	Unsafe water and sanitation	1.6	Unsafe sex	1.1
Low fruit and vegetable intake	0.8	Physical inactivity	1.4	Iron deficiency	1.0

Information was extracted from the WHO Global Alcohol Database (www.who.int/alcohol) and the Global Status Report on Alcohol Policy (WHO, 2004). Much of the information on national alcohol policies was originally provided by official sources in the countries or by key informants or from the published press. For countries where there is no national policy, as in the case of the United States and Canada, the most populous state was chosen to represent them nationally (California and Ontario, respectively). The following areas are covered:

1. Definition of an alcoholic beverage;
2. Age restrictions;
3. Restrictions on the availability of alcoholic beverages;
4. Restrictions on off-premise sale of alcohol;
5. Prices and taxation;
6. Drink and driving legislation;
7. Brief interventions for alcohol problems;
8. Advertising and sponsorship; and
9. Alcohol free environments.

RESULTS

Definition of an Alcoholic Beverage

This is important because that definition sets the limit for when the laws apply and to what beverages they apply. It is not, per se, an alcohol policy, but it is an area which has important

repercussions for legislative measures. There are wide discrepancies among the region as to what constitutes an alcoholic beverage: in many countries is 0.5%, in other countries it is much higher, such as Brazil [13% (for the purposes of advertising but for other purposes it is above 0.5%)] and Nicaragua (12%) thereby rendering beverages like beer not considered to be an alcoholic beverage. Some countries do not have a legal definition for what constitutes an alcoholic beverage (Table 6).

Age Restrictions

Setting minimum legal age limits helps preventing young people to have easy access to alcoholic beverages and has proven to be an effective measure, when enforced. Age limits can be set for buying or drinking alcohol, on and off premises, and for each type of beverage.

Among the 25 countries surveyed in the Americas, only Jamaica and Suriname have age limits at 16 years; Canada, and Nicaragua have age restrictions at 19 years and the United States

TABLE 6 Definition of an Alcoholic Beverage by Country

Argentina	0.5
Bahamas	No
Belize	3.5
Bolivia	2.0
Brazil	0.5
Canada	0.5
Chile	1.0
Colombia	0.5
Costa Rica	0.5
Dominican Republic	9.0
Ecuador	2.0
El Salvador	2.0
Guatemala	0.5
Guyana	—
Honduras	Definition is not in percentage of alcohol by volume
Jamaica	No legal definition
Mexico	2.0
Nicaragua	12.0
Panama	3.8
Paraguay	1.0
Peru	No legal definition
Suriname	6.0
Trinidad and Tobago	—
United States	0.5
Uruguay	0.5
Venezuela	Definition is not in percentage alcohol by volume

at 21. All the other countries have age limits at 18 years, for all types of beverages and for both on- and off-premises sales.

However, it is important to mention that these age limits are for purchasing alcohol only, not necessarily drinking it. Therefore, parents or other adults can buy these products and serve them to young people on premises and off premises, which makes it harder to enforce the law itself. In addition, in practice, it is known that most countries in the region rarely enforce the age limits.

Restrictions on the Availability of Alcoholic Beverages

Governments can have full control (state monopolies), partial control (licensing system), or no control over the production and sales of alcoholic beverages. Retail state monopolies exist only in Canada (sales of all alcoholic beverages), parts of the United States, Colombia (for spirits), Costa Rica, and El Salvador. Colombia, Costa Rica, and El Salvador have state monopolies on the production of distilled spirits as well.

As for licensing systems, all countries except Brazil require a license to produce alcoholic beverages. This requirement is limited to the production of distilled spirits in Trinidad and Tobago. Brazil is also the only country in the region without a licensing system to sell any type of alcoholic beverages, while in Jamaica such a system is required for selling wine and distilled spirits but not beer. All the other countries surveyed had a licensing system for selling alcoholic beverages.

Restrictions on Off-Premise Retail Sale

Governments can also restrict the days, hours, and places where alcoholic beverages are sold.

Most countries have some type of restriction over the hours, days, and places for alcohol sales, and the only known exception is Brazil, where no restrictions currently exist (except the day before elections, which is 1 day in the year, on average every 4 years). The restrictions are, however, very limited and many are not enforced. Only a few countries have restrictions on the density of outlets: Bolivia, Chile, Costa Rica, Guyana (for distilled spirits only), United States, and Venezuela (for distilled spirits only).

Prices and Taxation

Retail prices of alcoholic beverages are composed of the wholesale price plus profit and other costs. In addition, taxes specific to alcoholic beverages are often added. Taxes often differ according to the strength of the beverage (how much alcohol it has per volume). The data from the Americas region shows that, in summary:

- No taxes: Bahamas, Belize, and Costa Rica (as it has a monopoly and set the prices already);
- Taxes vary from 5% (Suriname) to 35% (Colombia), the majority being 10% to 20%, and according to the type of beverage;
- 52% of countries have taxes through excise stamps;
- 56% of the countries have taxes as percent of retail price; and
- There is no correlation between prices and taxation.

Overall, the prices are considered very low, making alcoholic beverages very affordable to everyone. Taxes have not kept up to inflation and therefore should not be seen as an ineffective measure but one that needs regular monitoring and updating to keep its desired effect.

Drink and Driving Legislation

As it was shown earlier injuries are an important cause of death and disability in the region, and traffic accidents are an important source of these injuries. The limits for blood alcohol levels are:

- Dominican Republic and Trinidad and Tobago: none;
- Colombia, Guyana, Jamaica, and Panama: 0% to 0.35%;
- Argentina, Brazil, Costa Rica, Chile, El Salvador, Peru, and Venezuela: 0.4% to 0.6%; and
- All other countries: 0.7% or greater.

However, most countries do not enforce these limits and the police often do not even have the equipment to measure such levels in drivers potentially under the influence of alcohol. Often there is no legislative provision for when the driver refuses to take a test and corruption is common. There are no treatment or education programs for repetitive offenders in most countries—they may exist in a few cities within a country but the global database includes only national policies.

In addition, only in the United States and Canada there are special measures to decrease traffic injuries related to alcohol such as driver's license suspension or graduated licensing system for new and young drivers.

BRIEF INTERVENTIONS FOR ALCOHOL-RELATED PROBLEMS

Brief interventions for early problems related to alcohol have not been widely disseminated in any country of the region, despite their demonstrated effectiveness (Babor et al., 2001; Chisholm et al., 2004). Significant training and dissemination exists in Canada and the United States, and good attempts at disseminating them started in Brazil, Cuba, Dominican Republic, Mexico, and El Salvador, all with the goal of integrating them in primary health care.

Advertising and Sponsorship

A few countries have bans on certain media and for certain beverages. Bahamas has a ban on national TV and radio for spirits. Venezuela has a ban on national TV and radio for all beverages and restrictions in print media and billboards. There were no restrictions on national TV, radio, print media and billboards for beer, wine and spirits reported for Canada, El Salvador, Guyana, Jamaica, Suriname, Trinidad and Tobago, and Uruguay. In Brazil, restrictions apply for spirits on national TV and radio. In Peru, such restrictions apply for wines and spirits on national TV and radio.

In Nicaragua and the United States, voluntary codes or self-regulation by the industry is the norm for all media. Chile has voluntary codes in national radio. All the other countries have partial restrictions (e.g., hours, type of programs or media, saturation limits and place of

advertisement) for all beverages and in some media (e.g., Mexico has partial restrictions only in national TV and no restrictions in the rest).

Sponsorships are an important part of alcohol marketing and promotion to expand the market, often directly targeting young people and other vulnerable groups. Sponsorship covers sports events, youth events, concerts, cultural events, national events, or celebrations, helping alcohol drinking to become an essential part of life in a society.

Guatemala and Costa Rica have banned sponsorship in sports and youth events. Panama and Venezuela have banned sponsorship of youth events only. Argentina, Bolivia, Colombia, Dominican Republic, Ecuador, Mexico, Paraguay, and Venezuela have partial restrictions on sponsorship for sport and youth events. Belize and Canada have partial restrictions in youth events. Brazil has voluntary restrictions in sports events only with the spirits. United States has voluntaries restrictions in youth events for all kinds of beverages. All other countries have no restrictions. However, countries do not have independent grievance panels or consumer boards to enforce legislation and it is perceived that the level of enforcement is rather low.

Argentina, Belize, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, and Venezuela have health warnings on advertisement.

Alcohol-Free Environments

Restricting alcohol consumption in public places could reduce some alcohol-related harm, including those related to driving. Despite the limited effectiveness of such restrictions, they could help in the development of social norms regarding alcohol consumption, to counterbalance the perception that alcohol has only positive effects and can be combined with any other activity. There are some restrictions on drinking in official and government buildings, and venues, public transportation, health and educational establishments, and in parks, streets, and beaches during sports and other leisure activities in about 50% of the countries surveyed. However, there is no information about their level of enforcement and the generalizability of findings at national level.

CONCLUSIONS AND IMPLICATIONS FOR RESEARCH AND POLICY

There are enormous gaps in knowledge regarding alcohol policies in the region. What was presented here is only a very partial snapshot on some aspects of alcohol policy and much more information is needed from developing countries in the region. Most Caribbean countries were not covered in the data collection undertaken by WHO for the global alcohol database and efforts continue to identify focal points to provide key information on alcohol policies, patterns of drinking, and access to statistics. More in-depth analysis of policies and experiences at local level would help to analyze barriers in implementation and their impact. This would facilitate the establishment of cross-country collaborations with developed countries and centers of excellence.

It is not known what would be the impact of changing general alcohol policies on drinking-and-driving fatalities and non-fatal injuries in Latin American countries. It would be useful to know the impact of changing specific policies to reduce drink and driving in an environment where other policies do not exist and other risk factors for traffic accidents are also of great magnitude (e.g., conditions of the road and education of drivers).

It is obvious, however, that there is ample ground for research and advocacy for effective alcohol policies in the region. The low level of enforcement of existing policies is seen as a major barrier which can be overcome with political commitment, public support, and intersectoral work. Most countries in the region have not carried research on the impact of policies or on the alcohol policy process and more remains to be done.

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Minimum Purchase Age Laws

How Effective Are They in Reducing Alcohol-Impaired Driving?

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Young drivers are less likely than adults to drive after drinking alcohol, but their crash risk is substantially higher when they do. This is especially true at low and moderate blood alcohol concentrations (BACs) and is thought to result from teenagers' relative inexperience with drinking, driving, and combining the two (Mayhew et al., 1986). Since July 1988, all 50 U.S. states and Washington, D.C., have had laws that require people to be at least 21 years old to purchase alcohol. Many other countries, however, allow people younger than 21 to drink alcohol. Minimum legal drinking ages are 16 to 18 in most European countries, 18 to 19 in Canada, 18 in Australia, and 20 in New Zealand (Stewart, 2000). Laws that establish a minimum age to drink alcohol are the primary legal mechanism limiting teenagers' access to alcohol. In the United States, zero tolerance laws that make it illegal for people younger than 21 to drive with any measurable amount of alcohol in their bodies, and minimum legal drinking age (MLDA) laws of 21 are the primary legal countermeasures against underage drinking and driving.

This paper summarizes trends in alcohol-impaired driving among people younger than 21, the history of minimum legal alcohol drinking age laws, and the evidence of their effects. Laws vary with regard to whether they prohibit the purchase, consumption, or possession of alcohol by underage people (here referring to those 20 and younger). For simplicity, the terms "drinking age" and "minimum legal drinking age," collectively abbreviated as MLDA, are used to refer to all of these types of laws. The paper focuses primarily on the United States, where the bulk of research has been conducted.

TRENDS IN UNDERAGE DRINKING AND DRINKING AND DRIVING

In the United States in 2004, 993 16- to 20-year-old passenger vehicle drivers fatally injured in crashes had positive BACs. This represented 31% of all fatally injured underage drivers ages 16 to 20 [Insurance Institute for Highway Safety (IIHS), 2005]. As shown in **Figure 1**, between 1982 and the mid-1990s there were substantial declines in the proportion of fatally injured drivers with positive BACs for drivers ages 16 to 20, 21 to 24, and 25 and older. For all three age groups, little progress has been made since the mid-1990s. Among fatally injured passenger vehicle drivers ages 16 to 20, 61% had positive BACs in 1982 compared with 31% in both 1995 and 2004. Similarly, among fatally injured passenger vehicle drivers ages 16 to 20, the proportion with BACs of 0.08% or higher was 53% in 1982, 24% in 1995, and 26% in 2004 (figure not shown) (IIHS, 2005).

Table 1 summarizes changes in the number and per capita rate of fatally injured drivers with positive BACs during 1982 to 1995 and 1995 to 2004. During 1982 to 1995, declines occurred among drivers of all ages, whether based on the number of deaths or per capita death rate. The largest declines in the number of fatally injured drivers with positive BACs occurred among the youngest drivers (ages 16 to 20), but there also were sizeable declines among drivers

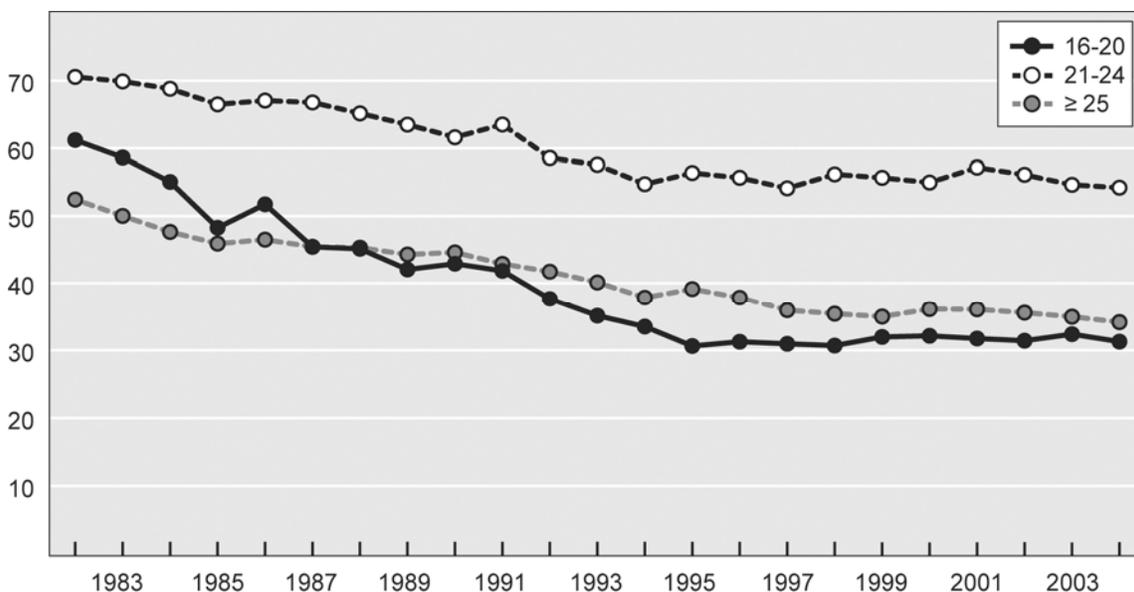


FIGURE 1 Percent of fatally injured passenger vehicle drivers with positive BACs by age, 1982–2004. Source: Fatality Analysis Reporting System (FARS), 1982–2004 (IIHS, 2005).

TABLE 1 Percent Change in Fatally Injured Drivers with Positive BACs by Driver Age: 1995 vs. 1982 and 2004 vs. 1995

	1995 vs. 1982		2004 vs. 1995	
	Number	Per Capita	Number	Per Capita
Age 16–20	–57	–50	+8	–6
Age 21–24	–39	–26	+5	–11
Age 25 and older	–9	–25	–11	–22

Source: FARS and U.S. Bureau of the Census, 1995–2004.

ages 21 to 24. Although the per capita death rate decreased during 1995 to 2004 among all age groups, the number of deaths increased among 16 to 20 and 21 to 24 year olds.

It is notable that the number of 16- to 20-year-old fatally injured passenger vehicle drivers with zero BACs increased by 54% during 1982 to 1995 and by 5% during 1995 to 2004. Thus, the large decline in fatally injured passenger vehicle drivers ages 16 to 20 with positive BACs during 1982 to 1995 was not part of a larger decline in overall deaths for this age group.

Summary statistics for young drivers often do not distinguish among different years of age. As shown in [Figure 2](#), the prevalence of drinking and driving among fatally injured passenger vehicle drivers increased with each year of age. During 1982 to 2004, the proportion of drivers who had been drinking declined among all ages, with the greatest decline among 16 year olds (64%) and the smallest decline among 20 year olds (36%).

Further evidence for declines in drinking and driving among underage drivers comes from national roadside breath surveys of weekend nighttime drivers (Voas et al., 1998). Among drivers younger than 21, the percentage with BACs of 0.05% or higher was 11% in 1973, 5% in

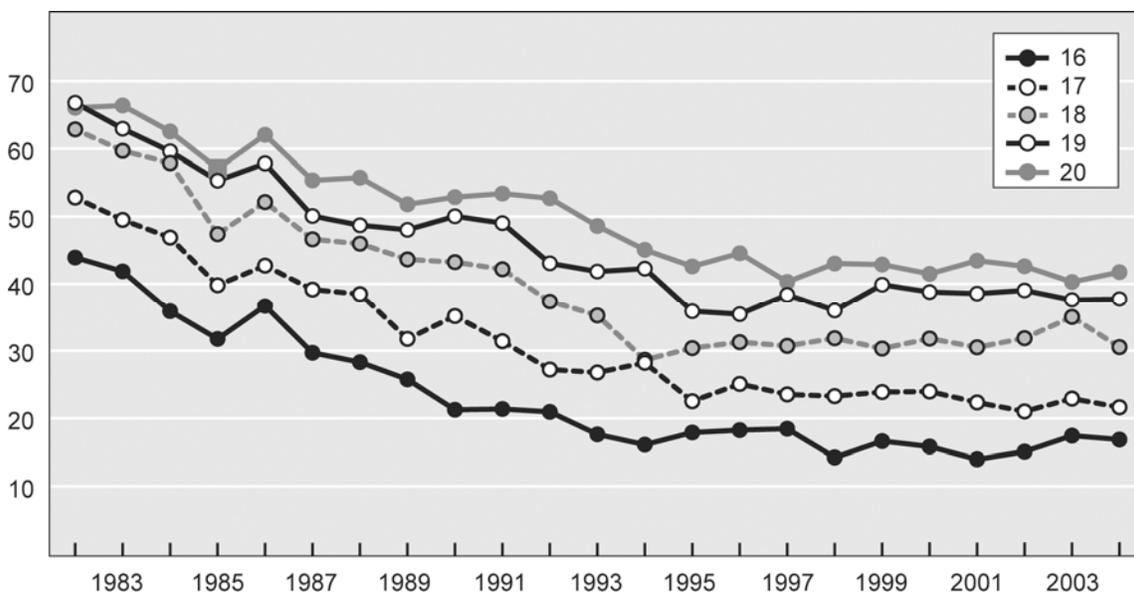


FIGURE 2 Percent of fatally injured passenger vehicle drivers with positive BACs by years of age, 1982–2004. Source: FARS, 1982–2004 (IIHS, 2005).

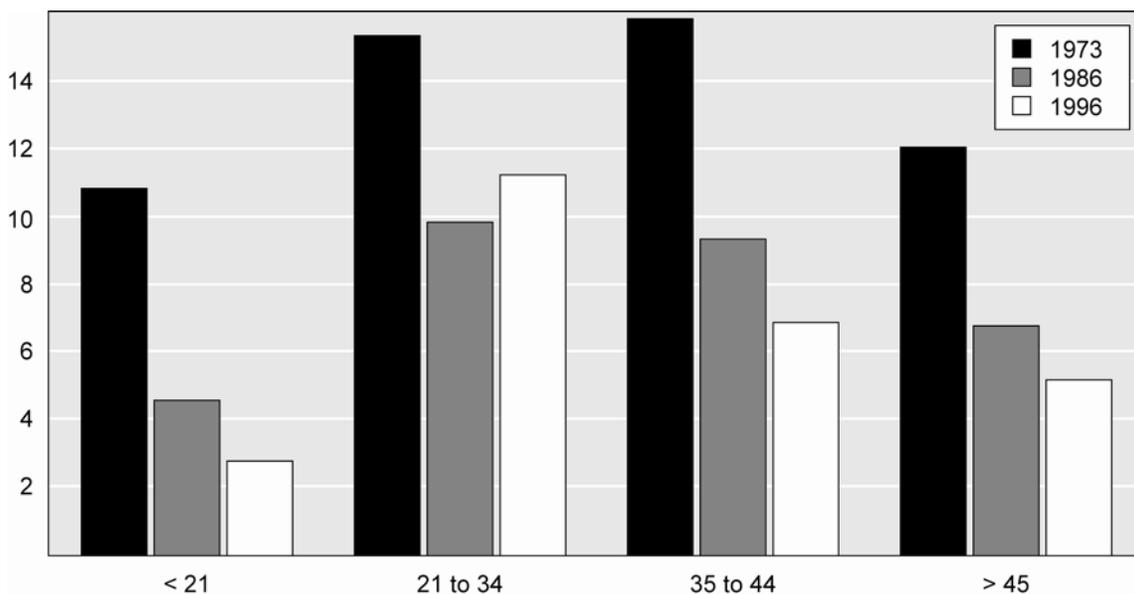


FIGURE 3 Percent of drivers with BAC $\geq 0.05\%$ in national roadside surveys by age, 1973, 1986, and 1996. Source: Voas et al., 1998.

1986, and 3% in 1996 (Figure 3). The change during 1973 to 1996 represented a 74% decline, much larger than the percentage declines for other age groups.

Based on the annual Monitoring the Future Surveys of youth, underage drinking in the United States has declined since 1979; however, most of this decline occurred by the early 1990s

(Johnston et al., 2005). After reviewing a number of surveys of drinking behavior, Hedlund et al. (2001) concluded that underage drinking declined substantially during 1982 to 1993 but at a slower rate than underage drinking driver fatal crash involvements (underage drinking decreased 22% and drinking driver fatal crash involvements decreased 61%). During 1993 to 1998, underage drinking increased gradually but drinking driver fatal crash involvements remained steady.

HISTORY OF MLDAs IN THE UNITED STATES

MLDAs underwent many changes in the 20th century, reflecting shifts in societal attitudes toward alcohol and alcohol-impaired driving, evolving views on the age at which the rights and responsibilities of adulthood should be conferred, and the influence of research on the effects of lowering or raising MLDAs. Some of the key events in the history of MLDAs are highlighted in [Table 2](#).

On January 16, 1919, the 18th Amendment to the U.S. Constitution was ratified, prohibiting the manufacture, sale, or transportation of intoxicating beverages. Nearly 15 years later, on December 15, 1933, prohibition ended with the ratification of the 21st Amendment. At that time, most states set MLDAs at 21. The most notable exceptions were Louisiana and New York (age 18) and Hawaii (age 20). Other exceptions were states with different MLDAs for different classes of alcohol (21 for liquor and fortified wine and a lower age, typically 18, for beer and wine). States made very few changes in MLDAs until the Vietnam era when they began lowering them. Most of the states that lowered MLDAs did so for all alcohol; others lowered them just for beer and wine.

The trend toward lowering MLDAs began in 1969 when Maine and Nebraska lowered their MLDAs from 21 to 20. With the lowering of the voting age to 18 in 1971, many states decreased the minimum age for other privileges of adulthood including marriage, the legal age of consent, and the purchase or consumption of alcoholic beverages. During 1966 to 1975, 30 states lowered their MLDAs, usually to 18. By the end of 1975, there remained only 12 states with MLDAs of 21. During the 1970s, several studies reported significant increases in crashes among affected age groups in states that had lowered their MLDAs (Whitehead et al., 1975; Williams et al., 1975). For example, Williams et al. (1975) found that lowering an MLDA to 18 was associated with a significant increase in fatal crashes among drivers younger than 21 that were most likely to involve alcohol (e.g., single-vehicle and nighttime crashes). Increases occurred among those directly affected by the law (ages 18 to 20) and also among younger teenagers (ages 15 to 17) not affected by the law change.

Partly as a result of research on the harmful effects of lower MLDAs, during 1976 to 1979 MLDAs were raised from 18 in eight states that had lowered them earlier in the decade. Seven of these states raised MLDAs incrementally, eventually reaching 21 in the 1980s. Michigan, however, made the jump from 18 to 21 in 1978, becoming the first state that had lowered an MLDA to raise it back to 21. As states restored MLDAs of 21, researchers examined the effects and found significant reductions in crashes among people younger than 21 (Hingson et al., 1983; Wagenaar, 1983; Williams et al., 1983) and some evidence of a positive spillover effect among younger drivers unaffected directly by the law change (Williams et al., 1983).

Fortified with this research, Mothers Against Drunk Driving and other advocacy groups lobbied states to enact MLDAs of 21. Nine states raised their MLDAs to 21 during 1980 to 1984, so

TABLE 2 History of MLDA Laws in United States

1933	21st Amendment repealed Prohibition; most states set MLDA at 21.
1966-75	Thirty states lowered the MLDA for some or all alcoholic beverages (Alabama, Alaska, Arizona, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, New Jersey, Rhode Island, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming). Only 12 states had age 21 MLDA in 1975 (Arkansas, California, Indiana, Kentucky, Missouri, Nevada, New Mexico, North Dakota, Oregon, Pennsylvania, Utah, and Washington).
1971	26th Amendment lowers voting age to 18.
1970s	Studies show teen crashes (particularly nighttime and single-vehicle fatal crashes) increased in states that lowered MLDA (Whitehead et al., 1975; Williams et al., 1975).
Early 1980s	Advocacy groups lobby for MLDA of 21 and 13 states started incrementally raising their MDLA (Connecticut, Florida, Georgia, Nebraska, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, Texas, West Virginia, and Wisconsin).
1978	Michigan is first state to restore age 21 MLDA.
1980-84	Nine states (Alaska, Arizona, Delaware, Illinois, Maryland, New Jersey, Oklahoma, Rhode Island, and Tennessee) pass MLDA of 21; total of 22 states have MLDA of 21 by the end of 1984.
1980-1985	Studies show decrease in teen crashes when MLDA is raised (Hingson, 1983; Wagenaar, 1983; Williams et al., 1983).
1984	Federal Uniform Drinking Age Act enacted (1984).
1985-1986	21 states (Alabama, Connecticut, Florida, Georgia, Hawaii, Iowa, Kansas, Maine, Massachusetts, Minnesota, Mississippi, Nebraska, New Hampshire, New York, North Carolina, South Carolina, Texas, Vermont, Virginia, West Virginia, Wisconsin) and Washington, D.C., pass MLDA of 21; total of 43 states and D.C. with MLDA of 21 by the end of 1986.
1987	Five states (Colorado, Idaho, Louisiana, Montana, Ohio) pass MLDA of 21.
1985-current	Numerous studies confirm increasing MLDA to 21 reduces teen crashes (DuMouchel et al., 1987; General Accounting Office, 1987; O'Malley et al., 1991; Shults, 2001; Wagenaar and Toomey, 2002).
1986	South Dakota and Wyoming are last to pass MLDA of 21.
Current	Studies continue on effects and enforcement of MLDA of 21.

that by the end of 1984 22 states had such MLDA. Although some states enacted MLDA of 21 on their own, others kept their existing MLDA, creating a patchwork of different MLDA across the nation. Inconsistent MLDA enabled minors who were too young to purchase alcohol in their own states to drive to nearby states where they could legally purchase or consume alcohol. In 1983, West Virginia dealt with this issue when it raised its MLDA from 18 for everyone to 19 for West Virginia residents and 21 for everyone else. The border issue added pressure to create a uniform MLDA of 21 (Presidential Commission on Drunk Driving, 1983). Safety groups lobbied Congress to enact legislation leading to a nationwide MLDA of 21.

Because the U.S. Constitution reserves to the states powers not specifically granted to the federal government and because the 21st Amendment gave states the right to regulate alcohol, the federal government could not enact a national MLDA of 21. Instead, Congress in 1984

enacted the Uniform Drinking Age Act. The act provided for a 5% reduction in federal highway funding to states without MLDAs of 21 for all alcoholic beverages by October 1, 1986, and a 10% loss of funding to states without MLDAs of 21 by October 1, 1987. The U.S. Supreme Court upheld the act when it was challenged as a violation of the 21st Amendment and the limitations of Congress' spending power under Art. I, 8, cl. 1 of the Constitution. The court noted that the act did not require any state to change its drinking age. The court reasoned that because Congress was under no obligation to make funds for highways available to the states, it was permissible for it to condition the grant of such funds on state enactment of an MLDA of 21 [*South Dakota v. Dole*, 483 U.S. 203 (1987)].

Between January 1, 1985, and October 1, 1986, 21 states and Washington, D.C., raised their MLDAs to 21. Five states followed suit by the end of 1987, and the last two states, South Dakota and Wyoming, enacted MLDAs of 21 by July 1, 1988. Numerous studies confirmed that raising MLDAs to 21 reduced teenage crashes [DuMouchel et al., 1987; General Accounting Office (GAO), 1987; O'Malley and Wagenaar, 1991; Shults et al., 2001; Wagenaar and Toomey, 2002], and researchers increasingly have focused on the enforcement of such MLDAs and other countermeasures to increase compliance.

Evidence of MLDA Effectiveness

Changes in states' MLDAs across time provided a fertile opportunity for researchers to assess the effects of raising or lowering MLDAs. There is now a large body of evidence of the substantial highway safety benefits of MLDAs of 21, including studies conducted in various jurisdictions and time periods and using different methods and measures of effectiveness.

Effect of MLDAs on Alcohol-Related Crashes

Several reviews of studies of the effects of MLDAs on crashes have been conducted (GAO, 1987; Shults et al., 2001; Wagenaar and Toomey, 2002). Wagenaar and Toomey (2002) examined 57 published studies containing 102 separate analyses for the effects of MLDAs on traffic crashes. Of the 66 analyses that reported significant effects, 98% found an association between higher MLDAs and decreased traffic crashes and the remaining 2% found the opposite. The Centers for Disease Control and Prevention conducted a systematic review of MLDA effects on crashes among drivers ages 18 to 20 (Shults et al., 2001). The 33 reviewed studies were those that were published as journal articles and met specified standards for methodological rigor. The findings were grouped into studies of the effect of lowering MLDAs, studies of the effect of raising MLDAs, and studies that used multiple regressions to evaluate the effect of MLDA changes. Overall, MLDA modifications resulted in changes of about 10% to 16% in alcohol-related crash outcomes for the targeted age groups, decreasing when MLDAs were raised and increasing when they were lowered. The effects were consistent across follow-up times, which ranged from 7 to 108 months.

Shults et al. (2001) identified nine studies that examined the effect of raising MLDAs on crashes involving adolescent drivers who were younger than MLDAs both before and after they were raised. A median decline in crashes of 6% was associated with raising MLDAs, but the effect size was inconsistent, with some studies showing no effect. Several studies examined a so-called "drinking experience" effect—i.e., an increase in crash involvements resulting from lack

of drinking experience when drivers reach an MLDA. Results were inconsistent because of difficulties in disentangling an experience effect from the MLDA effect.

Effects of MLDAs on Self-Reported Drinking

Several studies have reported that raising MLDAs was associated with decreased alcohol consumption (Hingson et al., 1983; O'Malley and Wagenaar, 1991). O'Malley and Wagenaar (1991) examined the effects of MLDAs of 21 on self-reported drinking during 1976 to 1981 using data from Monitoring the Future surveys. The study found that high school seniors drank more (as measured by mean 30-day alcohol use) in states with MLDAs of 18 than in states with MLDAs of 21, but throughout the 1980s alcohol use among high school seniors declined in states with MLDAs of 18 and 21. After controlling for sociodemographic and other variables, an MLDA of 21 was a significant predictor of lower alcohol consumption. O'Malley and Wagenaar (1991) reported that the lower alcohol consumption associated with an MLDA of 21 led to declines in fatal nighttime single-vehicle crashes among drivers younger than 21. The analyses also suggested that even after reaching age 21, those who were unable to purchase alcohol at a younger age consumed less alcohol than those able to purchase it at age 18.

Minimum Legal Drinking Age Laws in Other Countries

MLDAs in most European countries are 16 to 18. Surveys suggest that underage drinking is prevalent in Europe, although it varies widely by country. A recent survey of European high school students found a higher proportion of 15 to 16 year olds reported drinking alcohol in the past 30 days than was reported for 10th graders in the United States, based on data from the Monitoring the Future survey [National Academy of Sciences (NAS), 2003]. In addition, U.S. students were less likely than their European counterparts to report being intoxicated within the past year.

Canada provides the most apt comparison with the United States. MLDAs in Canada have been 18 to 19 for more than 20 years. Hedlund et al. (2001) examined trends in several measures of self-reported drinking and driving among U.S. and Canadian teenagers and trends in fatal crash involvements among Canadian and U.S. teenage drivers who had been drinking. Although the data sets for the two countries differed somewhat, the study found virtually identical patterns of reductions in drinking and driving and in alcohol-related crashes between about 1980 and the early to mid-1990s. Because the drinking age in Canada did not change during this period, and zero tolerance laws (prohibiting drivers younger than 21 from having any measurable alcohol in their bodies) were implemented in Canada and the United States after these reductions, the study concluded that some combination of other factors was responsible for the decline. This suggests that a proportion of the reductions in the United States may have resulted from these other factors as well. An alternative explanation is that every jurisdiction has looked for ways to reduce the problem of underage drinking and driving. In the United States, MLDAs were the primary tool. In other countries, other as yet identified strategies appear to have been the key.

Full Compliance with MLDAs of 21 in United States Has Not Been Achieved

According to the 2004 National Survey on Drug Use and Health, conducted by the U.S. Substance Abuse and Mental Health Services Administration (2004), 29% of underage people ages 12 to 20 drank alcohol in the past month, 20% had at least five drinks in the past month, and 6% had at least five drinks in the past month on at least five occasions. The mean age of first alcohol use was 15.6 years. Seventy-five percent of high school seniors have tried alcohol and 28% reported heavy drinking (five or more drinks in a row) in the past 2 weeks. In addition, 41% of eighth graders have tried alcohol and 11% reported heavy use (Johnston et al., 2005).

Surveys suggest that many underage people have ready access to alcohol. According to the 2004 Monitoring the Future survey, almost all (94%) of high school seniors believe it is fairly easy or very easy to get alcohol (Johnston et al., 2005). Among underage college students and high school juniors and seniors surveyed during 1994 to 1995 in New York and Pennsylvania, alcohol was obtained most frequently from friends (Preusser et al., 1997). Particularly for younger respondents, these friends often were underage. More than one-third of high school students and more than 60% of college students had tried to buy alcohol. About a third of college and high school students combined had used false identification to purchase alcohol.

Enforcement of MLDAs of 21 Can Reduce Teenagers' Access to Alcohol

Enforcement of underage drinking in private settings is highly problematic. The majority of enforcement efforts have been directed at retail or drinking establishments. During 1990 to 1991, researchers found that male shoppers ages 19 to 20 could easily purchase a six-pack of beer in Washington, D.C., and a New York City suburb (Preusser and Williams, 1992). However, youths were less successful in two upstate New York counties where police recently had cracked down on underage alcohol purchases. Without special funds, there may be scant enforcement of underage MLDAs, and the level of enforcement varies widely among jurisdictions (McCartt et al., 1989; Wagenaar and Wolfson, 1994). One barrier to rigorous enforcement of MLDAs is low funding for state alcohol beverage control agencies. This may inhibit not only the identification of servers, sellers, and purchasers who are violating the law but also the timely application of administrative penalties. Establishments do not always check teenagers' identification cards to establish age, and many teenagers obtain false identifications that are difficult to distinguish from official licenses. Home delivery services provide an avenue for sales of alcohol that are difficult to police. One study reported that 7% to 10% of underage people used home delivery services to get alcohol (Fletcher et al., 2000).

Preusser et al. (1992) found that young drivers were substantially underrepresented in the DUI (driving under the influence) arrest population relative to their contributions to the alcohol crash problem. It is very difficult to target young alcohol-impaired drivers. For example, young drivers with high BACs are more likely than drivers of other ages to be missed by police at sobriety checkpoints (Wells et al., 1997). Enforcement of zero tolerance laws reinforces enforcement of underage drinking laws. However, zero tolerance laws are difficult to enforce independent of DUI because offenders with low BACs are not likely to display the erratic driving that results in drivers with high BACs being stopped. In addition, in seven states (Massachusetts, Nevada, New Jersey, New Mexico, North Dakota, Rhode Island, and Tennessee) police must arrest a suspect for DUI before administering an alcohol test. As a result, although it

is illegal in these states for a person younger than 21 to drive with any measurable BAC, only those arrested for DUI may be tested (Ferguson et al., 2000).

Enhanced enforcement of MLDAs aimed at sellers and buyers can be effective in reducing underage access to alcohol. Sting operations using underage police agents at licensed retail sellers of alcohol were found to reduce agents' successful purchase of beer from 59% during baseline to 26% 4 months later after an extensive media campaign (Preusser et al., 1994). Community programs combining enforcement with other types of interventions (e.g., responsible beverage services training) also have been effective in reducing sales to minors (Grube, 1997; Wagenaar et al., 2005; Wagenaar et al., 2000), reducing attempted alcohol purchases by underage people and self-reported underage drinking (Wagenaar et al., 2000), reducing single-vehicle nighttime crashes among underage people (Holder et al., 2000), and reducing self-reported underage drinking and driving fatal crashes among drivers ages 15 to 25 (Hingson et al., 1996).

Are Further Reductions in Underage Drinking and Driving Achievable?

To summarize, a preponderance of evidence shows that MLDA is an effective deterrent to underage drinking and driving and has reduced alcohol-related crashes among young drivers. Yet many underage people still drink, many drink and drive, and alcohol remains an important risk factor in serious crashes of young drivers, especially as they progress through the teenage years.

It is unclear whether the ready availability of alcohol to underage people in many communities results from a lack of resources to enforce MLDAs, an underlying societal ambivalence toward underage drinking among many adults, or other factors. In fact, there is a movement once again to lower MLDAs, and a number of organizations have sprung up in recent years supporting this campaign [e.g., Americans for a Society Free from Age Restrictions (www.asfar.org) and National Youth Rights Association (www.youthrights.org)]. To the extent that society is willing to accept some drinking by underage people, high levels of compliance with MLDAs of 21 will be difficult to attain. Therefore, it is reasonable to ask whether most of the highway safety benefits from such MLDAs have been achieved or whether other strategies should be implemented.

Strict enforcement seems the key to increase compliance with MLDAs of 21. States' MLDAs are not all alike, and some are more easily enforced than others. For example, although all states prohibit the sale of alcohol to minors and possession of alcohol by minors is illegal, it is difficult to prove possession unless the minor is found in possession of alcohol in its original container. Also, the strength and enforceability of states' dram shop liability laws (allowing a person injured by someone under the influence of alcohol to recover damages from the retailer who served or sold the alcohol) vary widely. Deficiencies in laws pertaining to underage drinking may inhibit enforcement, but little research has addressed the extent to which specific components of MLDAs affect enforcement of underage drinking or drinking and driving (Fell et al., 2006).

Other strategies in addition to closing loopholes in MLDAs of 21 and tougher enforcement may help to reduce underage drinking and drinking and driving. Many are spelled out in the report by the NAS's (2003) Developing a Strategy to Reduce and Prevent Underage Drinking Committee. The committee recommended increasing the excise tax on alcohol, based on research that found an inverse relationship between the price of alcohol and consumption levels. This strategy, however, will face strong opposition from the alcohol industry. Other

recommendations included stronger controls on the advertising and promotion of alcoholic beverages and on the availability of alcohol in retail settings (e.g., outlet density and restrictions on hours of sale) (NAS, 2003; Williams et al., in press). Enforcing MLDA of 21 in private settings is problematic. So-called social host liability laws are statutes or judge-made laws permitting someone to sue a host who provided alcohol to an intoxicated person who then caused an injury or death. Although not well researched, such laws may be a powerful tool against extra-establishment drinking among underage people, and these laws are being considered by an increasing number of states (Insurance Journal, 2006).

As indicated in Figure 4, for people ages 15 to 25 there is a close association between reported alcohol consumption, as measured by drinking in the past 30 days, and the percentage of fatally injured drivers.

These two indicators track closely as age increases. Both reported drinking and the percentage of fatally injured drivers who had been drinking increase with each additional year of age between 16 and 21 and then change little. This suggests that enforcement and other efforts focusing on older underage people may be especially beneficial. This may include, for example, highly publicized enforcement of laws pertaining to underage drinking and to drinking and driving in college communities. It also suggests that states should consider extending the nighttime and passenger restrictions in graduated licensing laws to include older teenagers.

Recent surveys by the NHTSA of the driving age public found that increased enforcement ranks higher as a strategy for reducing alcohol-impaired driving than measures to reduce the availability of alcohol or to raise taxes on alcoholic beverages (Royal, 2003). About 70% of respondents thought penalties for drinking and driving should be raised. However, there is reasonable public support for a wide range of policies, as exemplified by a national opinion survey that found at least half of adults supported 29 of 33 different policies. The top 10 policies

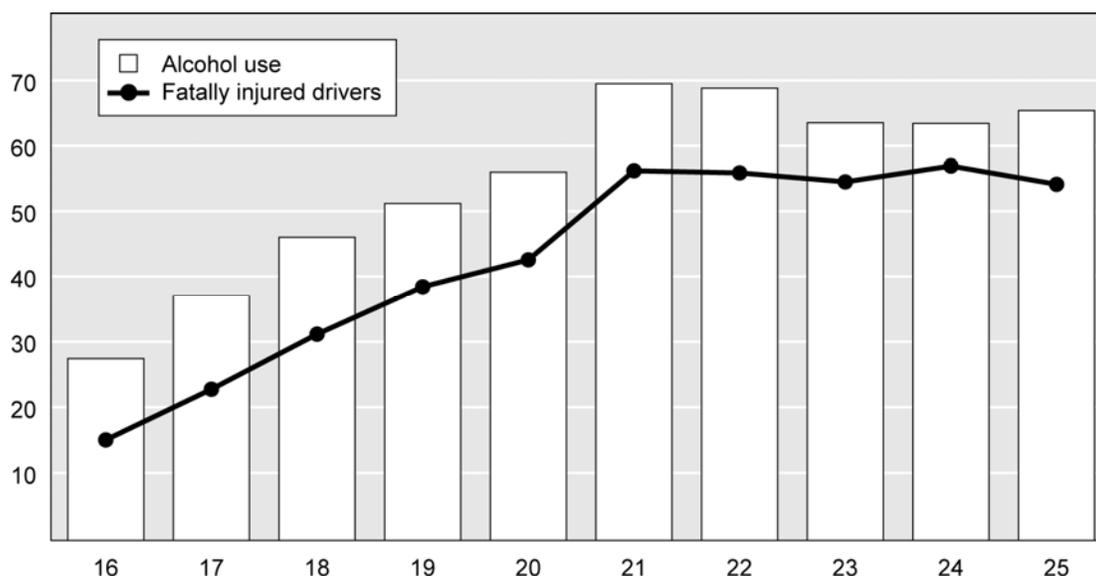


FIGURE 4 Percent of reported alcohol use in past 30 days (2004) and percent of fatally injured passenger vehicle drivers with positive BACs (2000–2004) by years of age 16 to 25. [Source: FARS, 2000–2004, and Substance Abuse and Mental Health Services Administration (SAMHSA), 2004.]

(all with more than 80% support) included restricting drinking on city streets or in parks; requiring server and bar owner training; restricting drinking at college campuses, concerts, and street fairs; tip lines to report illegal sale or use; the punishment of adult providers; and tax increases for prevention purposes (Harwood et al., 2002).

Combining a variety of alcohol control countermeasures with increased enforcement of MLDAs of 21 may provide the most hope for reducing underage drinking and underage drinking and driving. However, given current societal attitudes toward drinking and limited resources, substantial progress may not be achievable without new and bold approaches, such as in-vehicle technologies that prohibit people from driving with specified BACs.

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New Zealand Lowers Drinking Age *Case Study*

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MINIMUM PURCHASING AGE FOR ALCOHOL AND TRAFFIC CRASH INJURIES AMONG 15- TO 19-YEAR-OLDS IN NEW ZEALAND

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OBJECTIVES

In 1999, New Zealand lowered the minimum purchasing age for alcohol from 20 to 18 years. We tested the hypothesis that this increased traffic crash injuries among 15- to 19-year-olds.

METHODS

Poisson regression was used to compute incidence rate ratios for the after to before incidence of alcohol-involved crashes and hospitalized injuries among 18- to 19-year-olds and 15- to 17-year-olds (20- to 24-year-olds were the reference).

RESULTS

Among young men, the ratio of the alcohol-involved crash rate after the law change to the period before was 12% larger [95% confidence interval (CI) = 1.00, 1.25] for 18- to 19-year-olds and 14% larger (95% CI = 1.01, 1.30) for 15- to 17-year-olds, relative to 20- to 24-year-olds. Among young women, the equivalent ratios were 51% larger (95% CI = 1.17, 1.94) for 18- to 19-year-olds and 24% larger (95% CI = 0.96, 1.59) for 15- to 17-year-olds. A similar pattern was observed for hospitalized injuries.

CONCLUSIONS

Significantly more alcohol-involved crashes occurred among 15- to 19-year-olds than would have occurred had the purchase age not been reduced to 18 years. The effect size for 18- to 19-year-olds is remarkable given the legal exceptions to the pre-1999 law and its poor enforcement.

Status of 14 Under-Age-21 Drinking Laws in the United States

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Perhaps no alcohol safety measure has attracted more research and public attention or shown more consistent evidence for its effectiveness than the minimum legal drinking age (MLDA) 21 law in the United States (1). Enacted in 1984, it was the first law for which the U.S. Congress, under the Highway Safety Act, imposed a sanction on states that did not enact a MLDA-21 law by withholding federal highway construction funds. In 1995, Congress imposed a similar sanction on states failing to enact zero tolerance (ZT) laws that made it an offense for drivers aged 20 and younger to operate a vehicle with any amount of alcohol in their system. Between 1982 and 1998, the population-adjusted involvement rate of drinking drivers aged 20 and younger in fatal crashes decreased 59% (2). MLDA-21 laws have been shown to be associated with this decline (3–5). The NHTSA has estimated that MLDA laws save more than 900 lives a year in traffic fatalities alone (6), and there is substantial evidence that ZT laws are saving additional lives (5,7,8). Recently, some states have adopted graduated driver licensing (GDL) laws that restrict nighttime driving for young drivers, thus potentially further reducing alcohol-related crashes among persons aged 20 and younger (9).

UNDERAGE DRINKING PROBLEM IN THE UNITED STATES

Since 1988, the minimum legal age to purchase or possess alcohol has been 21 in all of the United States. Yet almost half of 8th graders and about three-quarters of high school seniors report that they have consumed alcohol at some time during the past year. More than half of high school seniors reported being drunk within the past year (10), and almost a third of the youths in this country reported drinking alcohol at age 16 or younger. Two-thirds of youths reported initiating drinking at age 18 or younger (11). Youths aged 12 to 17 who reported drinking alcohol within the past month were more than twice as likely to get involved in school fights as were youths who did not drink alcohol (12). Nearly half of all college students reported participating in high-risk (or binge) drinking (five or more drinks per session) during the year (13, 14). Alcohol has been shown to be involved in more than 40% of all college student academic problems and 28% of all college dropouts (15). More than 2,400 youths aged 15 to 20 are killed annually in alcohol-related traffic crashes (16). Twenty years ago, close to 5,500 youths aged 15 to 20 died in alcohol-related traffic crashes (16). The relative risk of being killed in a single-vehicle crash for young males (aged 16 to 20) at blood alcohol levels as low as .02 to .04 is almost five times that of sober male drivers of the same age (17). Underage drinking is related to youth crime, suicides, rapes, assaults, alcohol poisoning, and unintentional injuries. This costs society close to \$62 billion annually (18).

New medical research shows that the brain is not fully developed until about age 21 in most people. Excessive drinking by youth may cause irreversible brain damage and reduce brain function performance by as much as 10% (19). Recent research shows that the early onset of

drinking by youth increases their risk in the future for alcohol-abuse problems (20) and alcohol-related crashes and assaults (11). There is a misconception that countries with lower drinking ages do not experience the youth alcohol problems that the United States has and that youth in those countries drink responsibly. On the contrary, most European countries with lower drinking ages than the United States experienced substantially higher percentages of youth who reported engaging in high-risk (binge) drinking and self-reported intoxication within the past month (21).

Even without strict enforcement, MLDA-21 laws still save more than 900 lives per year in reductions in traffic fatalities involving young drivers (6, 22, 23). From 1988 (when all states had enacted such legislation) to 1995, alcohol-related traffic fatalities for youth aged 15 to 20 declined from 4,187 to 2,212, a 47% decrease. Since that time, however, this decline has ended; youth alcohol-related fatalities now fluctuate between 2,200 and 2,400, including slight increases since 1998. The rate of underage drinking drivers in fatal crashes varies considerably by state (24). This stagnation has occurred despite the passage by all states of ZT laws for underage drivers, which were designed to strengthen MLDA-21 laws. Toomey et al. (1) provided examples of how effective the MLDA-21 laws have been without apparent enforcement. In a recent *Alcohol Alert*, the National Institute for Alcohol and Alcohol Abuse (NIAAA) documented the immediate and long-term risks associated with underage drinking and the need for effective prevention and treatment programs, including the reduction of alcohol availability to youth (25). These risks include becoming addicted to alcohol, being injured while impaired, getting into fights, and having unprotected sex while impaired.

METHODS

Underage Drinking Laws in the United States

Stimulated by the scientific and safety advocate support for limiting underage access to alcohol, a basic set of 14 laws directed at (a) control of sales to youth, (b) possession and consumption of alcohol by youth, and (c) prevention of impaired driving by those aged 20 and younger has been adopted over the last two decades in many of the 50 states and the District of Columbia. However, public ambivalence regarding those laws has resulted in substantial variation between states in the comprehensiveness of such legislation. These state differences manifest themselves in many ways. For example, although all states make it unlawful for an underage person to possess alcohol, it is not illegal in some states for an underage person to consume or purchase alcohol. Further, some states have ZT laws that are unenforceable because police officers cannot take a youth into custody or transport them to the police station for a breath test unless they can demonstrate that the youth has a blood alcohol concentration (BAC) higher than the adult limit (26). Finally, not all states have GDL laws, and some states that have GDL laws do not include a provision restricting nighttime driving, a time when alcohol is most likely to be a factor (27). Clearly, the varying laws across each state and the strengths and limitations of those state laws work together to produce different levels of deterrence. Despite strong public and congressional support, in some localities, there is considerable opposition to these laws. In fact, five states have legislative provisions that would automatically repeal their MLDA 21 law if Congress repealed the penalty for not having such a law (1). Thus, the extent to which states should devote resources to controlling alcohol sales and consumption by young people remains an important policy question, at least at the local level.

Data Sources for Underage Drinking Laws

The primary source of data for underage drinking laws in the states is the NIAAA Alcohol Policy Information System (APIS) dataset (1998–2005). APIS provides information on 13 of the laws discussed in this document. For the final law, GDL, we have used information from the Insurance Institute for Highway Safety (IIHS) (28).

RESULTS

Fourteen Key Underage Laws

The public generally assumes that the MDLA 21 is embodied in a single law and, therefore, all states have essentially the same law. In actuality, the MLDA 21 has multiple provisions targeting outlets that sell to minors; adults who provide to minors; and underage persons who purchase or attempt to purchase, possess, or consume alcohol. In addition, there are companion laws that provide for lower BAC limits for underage drivers, GDL, and other legislation such as keg registration and social host liability laws (Table 1). These laws vary considerably from state to state, and no state has all of the 14 law components or regulations that were documented. Thus, the current U.S. effort to control underage drinking involves a variable package of measures. Recently, the NIAAA undertook a significant project to document all federal and state alcohol-related laws, policies, and regulations. NIAAA has posted the initial information on a website, called APIS, for use by investigators concerned with alcohol prevention and treatment programs. For each of the 50 states and D.C., the APIS database covers 13 of the 14 basic laws relating to underage drinking and underage drinking and driving. Therefore, to conduct a comprehensive study of all 14 major laws, we used APIS as the source for the 13 basic laws and then added information from IIHS for the remaining law. Below is a brief description of each of the 14 laws:

1. **Possession.** All states prohibit possession of alcoholic beverages by people aged 20 and younger; however, many states have one or more of the eight exceptions to this law, such as drinking in private locations. Note that possession refers to a container, not alcohol in the body. The data for this law came from the NIAAA APIS (updated through 1/1/2005).
2. **Consumption.** States are coded as having this law if their policies specifically prohibit minors (defined in this document as under age 21) from consuming alcoholic beverages. Note that this means observed drinking in most cases, not merely the presence of a positive BAC from a breath test. Many states have one or more exceptions to this law. The data for this law come from the NIAAA APIS (updated through 1/1/2005).
3. **Purchase.** States were coded as having this law if their policies specifically prohibit the purchase of alcoholic beverages by minors. Many states have one or more exceptions to this law. The data for this law came from the NIAAA APIS (updated through 1/1/2005).
4. **Furnishing or selling.** All states have laws prohibiting the furnishing of alcoholic beverages to minors. Many states have one or more exceptions to this law. The data for this law came from the NIAAA APIS (updated through 1/1/2005).
5. **Age for on-premises servers and sellers.** States were coded as having this law if the minimum age for both serving and bartending all three beverage types—beer, wine and spirits—was 21. The data for this law came from the NIAAA APIS (updated through 1/1/2005).

TABLE 1 Status of 14 Key Underage Drinking Laws in the United States, June 2006

	(1) Possession (APIS)	(2) Consumption (APIS)	(3) Purchase (APIS)	(4) Furnishing/selling (APIS)	(5) Age 21 for on-premises servers/seller (APIS)	(6) Age 21 for off-premises servers/sellers (APIS)	(7) ZT (APIS)	(8) Use and Lose (APIS)	(9) Keg registration (APIS)	(10) RBS training (ABC)	(11) Use of ake ID (APIS)	(12) Social host—underage parties (APIS)	(13) GDL with night restrictions (IHHS, CC)	(14) State control of alcohol (PIRE)	Score (has law)
AL	x	x	x	x			x	x		x	x	x	x	x	11
AK	x	x	x	x	x	x	x			x	x		x		10
AZ	x	x	x	x			x	x		x	x	x			9
AR	x		x	x			x			x	x				6
CA	x		x	x			x	x	x	x	x		x		9
CO	x	x	x	x		x	x	x		x	x		x		10
CT	x		x	x			x	x	x		x		x		8
DE	x	x		x		x	x	x		x	x		x		9
DC	x	x	x	x			x	x	x	x	x		x		10
FL	x		x	x			x	x		x	x	x	x		9
GA	x		x	x			x	x	x		x		x		8
HI	x		x	x			x				x	x	x		7
ID	x	x	x	x			x	x	x		x		x	x	10
IL	x	x	x	x			x	x		x	x	x	x		10
IN	x	x		x			x	x	x	x	x		x		9
IA	x		x	x			x	x			x		x	x	8
KS	x	x	x	x		x	x	x			x	x			10
KY	x		x	x			x				x				5
LA	x	x	x	x			x	x	x	x	x		x		10
ME	x	x	x	x			x		x	x	x	x	x	x	11
MD	x		x	x			x	x	x	x	x	x	x		10
MA	x		x	x			x	x	x		x	x	x		9
MI	x	x	x	x			x			x	x	x	x	x	10
MN	x	x	x	x			x		x		x				7
MS	x		x	x		x	x	x			x		x	x	9

(continued)

TABLE 1 (continued) Status of 14 Key Underage Drinking Laws in the United States, June 2006

	(1) Possession (APIS)	(2) Consumption (APIS)	(3) Purchase (APIS)	(4) Furnishing/selling (APIS)	(5) Age 21 for on-premises servers/seller (APIS)	(6) Age 21 for off-premises servers/sellers (APIS)	(7) ZT (APIS)	(8) Use and Lose (APIS)	(9) Keg registration (APIS)	(10) RBS training ABC)	(11) Use of ake ID (APIS)	(12) Social host—underage parties (APIS)	(13) GDL with night restrictions (IHS, CC)	(14) State control of alcohol (PIRE)	Score (has law)
MO	x		x	x			x		x		x		x		7
MT	x	x	x	x			x	x		x	x		x	x	10
NE	x	x	x	x			x		x		x		x		8
NV	x		x	x	x		x	x		x	x		x		9
NH	x		x	x			x	x	x	x	x	x	x	x	11
NJ	x	x	x	x			x	x		x	x	x	x		10
NM	x		x	x		x	x	x	x	x	x		x		10
NY	x			x			x		x	x	x		x		7
NC	x	x	x	x			x	x		x	x		x	x	10
ND	x	x	x	x		x	x		x		x				8
OH	x	x	x	x			x				x	x	x	x	9
OK	x		x	x		x	x	x	x		x		x		9
OR	x	x	x	x			x	x	x	x	x	x	x	x	12
PA	x	x	x	x			x	x		x	x	x	x	x	11
RI	x		x	x			x	x	x	x	x		x		9
SC	x		x	x			x	x			x	x	x		8
SD	x	x	x	x			x	x	x	x	x		x		10
TN	x	x	x	x			x	x		x	x		x		9
TX	x	x	x	x			x	x		x	x		x		9
UT	x	x	x	x	x	x	x	x	x	x	x		x	x	13
VT	x	x		x			x		x	x	x			x	8
VA	x		x	x			x	x	x		x		x	x	9
WA	x	x	x	x			x	x	x	x	x	x	x	x	12
WV	x	x	x	x			x				x		x	x	8
WI	x	x	x	x			x	x		x	x	x	x		10
WY	x		x	x		x	x	x		x	x		x	x	10
Total # with law	51	30	47	51	3	10	51	37	26	33	51	18	44	18	Avg. Score 9.2

6. **Age for off-premises servers and sellers.** States were coded as having this law if the minimum age for selling beer, wine, and spirits was 21. The data for this law came from the NIAAA APIS (updated through 1/1/2005).

7. **Zero tolerance.** In all states it is illegal for people under 21 to drive with any measurable level of alcohol in their systems. States were coded as having this law if the minimum BAC limit for underage operators of noncommercial automobiles, trucks, and motorcycles was $\leq .02$. The data for this law came from the NIAAA APIS (updated through 1/1/2004).

8. **Use and lose.** This term describes laws that authorize driver licensing actions against persons found to be using or in possession of illicit drugs, and against young persons found to be drinking, purchasing, or in possession of alcoholic beverages. States vary in how many of the alcohol violations (i.e., underage purchase, possession, consumption) lead to a violation as well as whether the license suspension or revocation for violating the law is mandatory versus discretionary. The data for this item came from the APIS website using data of Use and Lose laws (updated as of 1/1/2005).

9. **Keg registration.** States were coded as having this law if they required wholesalers or retailers to attach an identification number to their kegs and collect identifying information from the keg purchaser. The state of Utah bans kegs altogether. For the purposes of this study, Utah was coded as having a keg registration law, since banning kegs is considered a stronger method of keg regulation. The data for this law came from the NIAAA APIS (updated through 1/1/2005).

10. **Responsible beverage service (RBS) training.** Beverage service training and related practices establish requirements or incentives for retail alcohol outlets to participate in programs (often referred to as RBS or server training programs) to (a) develop and implement policies and procedures for preventing alcohol sales and service to minors and intoxicated persons and (b) training managers and servers or clerks to implement policies and procedures effectively. Such programs may be mandatory or voluntary. In APIS, a program is considered to be mandatory if state provisions require at least one specified category of alcohol retail employees (clerks, managers, or owners) to attend training. States with voluntary programs offer incentives to licensees to participate in RBS training such as discounts on dram shop liability insurance and protection from license revocation for sales to minors or intoxicated persons. This information came from the NIAAA APIS (updated through 7/01/2005).

11. **Use of fake identification.** All states prohibit the use of false identification cards by minors. In some states, it is illegal to transfer an ID to another. In most states it is illegal to produce a fake ID. Data for this law came from the NIAAA APIS (updated through 1/1/2005).

12. **Social host liability and underage parties.** Social host liability refers to a law holding individuals criminally responsible for underage drinking events on property they own, lease, or otherwise control. States were coded as having this law if any of the following actions by underage guests can cause a violation: possession, consumption, and intention (to possess or consume). The data for this law component came from the NIAAA APIS (updated 1/1/2005).

13. **GDL with night restrictions.** GDL is a system in which beginning drivers are required to go through three stages of limited driving privileges. The first stage is a supervised learner's period; the second stage is an intermediate period where unsupervised driving in high-risk situations is limited; and the final stage is a full-privilege driver's license. States were coded as having this law if they had a three-stage GDL system and if they had restrictions on the nighttime driving hours during the intermediate stage. Limitations on nighttime driving are

designed to reduce drinking and driving by underage drivers. Nighttime restrictions for underage novice drivers may also reduce underage drinking since there may be limited means to get to the place of drinking. Information for this law was provided by the IIHS (2005).

14. **State control of alcohol.** There are two types of alcohol distribution: license and control. Although all states regulate the distribution of alcohol to some extent, in control states, the state is the exclusive seller in a particular sector of the business. States were coded as having this law if they maintain some type of monopoly control over one or more types of retail alcohol sales. This information was drawn from the NIAAA APIS (updated through 1/1/2004).

Table 1 summarizes the status of the 14 key elements of state laws and regulations relating to underage drinking and impaired driving. If a state has a particular law, there is an X in that cell; empty cells indicate states that do not have a particular provision of the law. The column titled “score” provides a total for each state, indicating how many underage laws the state has. The mean score for all the states and D.C. out of a maximum possible score of 14 is 9.2, with a range of 5 to 13. Thus, aside from issues relating to the level of enforcement and the publicity given to underage laws, there is substantial variation in the completeness with which states have adopted all components of these laws. Also, even if a state has a particular law component, there may be exceptions and provisions that substantially weaken the law. These should be taken into consideration in any research on the effects of the laws.

DISCUSSION OF STRATEGIES

Most basic underage drinking laws have been in place since the mid-1980s and have produced a substantial reduction in underage drinking. Nevertheless, teenagers as young as 13 appear to find it easy to obtain alcohol, and alcohol-related deaths of drivers aged 20 and younger remain a serious problem. A comprehensive report on strategies to reduce underage drinking in this country by a committee established by the National Academy of Sciences (NAS) Institute of Medicine (29) was recently released. The report was developed in response to a congressional request for the committee to review a broad range of federal, state, and nongovernmental programs, including environmental interventions and programs focused on youth attitudes and behaviors, and to develop effective strategies to reduce and prevent underage drinking. The NAS recommendations for limiting access of alcohol to youth are shown in [Table 2](#). These policies and several others recommended by the NAS committee are embodied in the current set of 14 key measures ([Table 1](#)) that many states have legislated to control underage drinking and impaired driving. However, none of the states have enacted all 14 laws, and many states that have these laws provide for important exceptions to them.

The NAS report has substantial potential to influence policy on future strategies to reduce and prevent underage drinking, including both state legislation and program policies. In addition, it may influence resource allocations, an important factor as most states have implemented their underage laws without providing accompanying funds for increases in existing law enforcement levels (25). The NAS report also is significant because it points to the need for improved enforcement. Yet in some cases, the specific provisions of these laws actually restrict their enforcement (26).

TABLE 2 NAS Recommendations for Limiting Alcohol Access to Youth

Recommendation 9-1: The MLDA of each state should prohibit
<ul style="list-style-type: none"> • Purchase or attempted purchase, possession, and consumption of alcoholic beverages by persons under 21; • Possession of and use of falsified or fraudulent identification to purchase or attempt to purchase alcoholic beverages; • Provision of any alcohol to minors by adults, except to their own children in their own residences; and • Underage drinking in private clubs and establishments.
Recommendation 9-8: States and communities should establish and implement a system requiring registration of beer kegs that records information on the identity of purchasers.
Recommendation 9-9: States should facilitate enforcement of ZT laws in order to increase their deterrent effect. States should modify existing laws to allow passive breath testing, streamlined administrative procedures, and administrative penalties and implement media campaigns to increase young peoples' awareness of reduced BAC limits and of enforcement efforts.
Recommendation 9-10: States should enact and enforce graduated driver licensing laws.
Recommendation 9-13: States should strengthen efforts to prevent and detect use of false identification by minors to make alcohol purchases.
States should <ul style="list-style-type: none"> • Prohibit the production, sale, distribution, possession, and use of false identification for attempted alcohol purchase; • Issue driver licenses and state identification cards that can be electronically scanned; • Allow retailers to confiscate apparently false identification for law enforcement inspection; and • Implement administrative penalties (e.g., immediate confiscation of a driver's license and issuance of a citation resulting in a substantial fine) for attempted use of false identification by minors for alcohol purchases" (29).

Ramirez and Fell (30), in a project sponsored by NHTSA and working with the National Liquor Law Enforcement Association, summarized state laws and penalties dealing with alcohol law enforcement. Although the enforcement of state alcohol laws appears to be an effective strategy for reducing underage drinking and associated deaths and injuries, very little is actually known about the variation that exists across states in relation to alcohol laws and penalty provisions. Ramirez and Fell (30) provided a preliminary analysis of specific state alcohol laws and penalties that pertain to reducing underage drinking.

CONCLUSION

The results from this research can be used to recommend stronger and more effective laws to reduce underage drinking and underage drinking and driving. It is clear that no states have all 14 key components of the MLDA 21-related laws. At best, only a handful of states have 11 or more of the 14 laws and regulations (Alabama, Maine, New Hampshire, Oregon, Pennsylvania, Utah, and Washington). Even without substantial enforcement, it is important that states adopt these laws (1) in order to have a good foundation in preventing, or at least reducing, underage drinking.

Further research is needed to address the following questions:

- What clusters of the 20 MLDA 21 law components are associated with significant decreases in underage drinking drivers involved in fatal crashes?
- What characteristics of the state (other laws, enforcement intensity, etc.) are associated with significant decreases in underage drinking driver fatal crashes?
- What are the strengths and limitations of the 14 components of the underage drinking laws and are they related to underage drinking deterrence?

This will help states establish a legislative agenda that will focus on the most effective laws and policies they do not already have.

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Limits on Outlet Density and Location *Effects on Traffic Safety*

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Many communities in the United States have the option to apply powerful planning and zoning regulations to constrain the locations and operating conditions of alcohol outlets. These towns and cities can use specific planning and zoning regulations like conditional use permits to determine the number and locations of alcohol outlets and set specific operating conditions for outlets (e.g., for noise abatement) within general regulatory guidelines provided by state governments. In California, for example, cities like San Francisco can use conditional use permits to constrain the proliferation of alcohol outlets, outlets otherwise licensed by the state and restricted in numbers proportional to population size (i.e., one on-sale general licensed outlet per 2,000 and one off-sale general licensed outlet per 2,500 persons). The permit process can constructively shape the distribution of alcohol outlets within community settings (e.g., distancing them from schools). Regrettably, a combination of market forces and competition between outlets, lax governmental regulation, and licensing rules that enable licenses to be transferred across city and county boundaries defeats the basic public health goals these regulations were designed to achieve. Cities like San Francisco find themselves with up to twice as many alcohol outlets than were intended by these regulations and, within smaller areas of the city, upwards of four to eight times the expected numbers of outlets per person. If health problems are consistently related to numbers and overconcentrations of alcohol outlets, then there is good reason to regulate outlet densities for the common welfare of community members. If, in addition, specific patterns of problem behaviors appear to be related to certain types of outlets, these outlet types should be specifically regulated to minimize harm.

This paper summarizes what is currently known about relationships between outlet densities and two problems related to traffic safety: motor vehicle crashes and pedestrian injury collisions. Much of the work that has been done in this area has been from a transdisciplinary perspective. For that reason, the multiple disciplinary approaches to understanding the relationships of alcohol outlets to traffic safety will be emphasized. Theoretical and empirical research from these perspectives will be reviewed. The paper concludes with a theoretical integration of these different perspectives that emphasizes the agent-based nature of drinking and driving, drunken driving and motor vehicle crashes; drinkers acting as agents who drive after drinking in the context of dynamically changing social constraints. It will be argued that these constraints act to ensure the persistence of drinking and driving and drunken driving within communities. Modifications of these constraints may also be used to reduce these alcohol problems.

GEOGRAPHIC EPIDEMIOLOGY 1: OUTLET DENSITIES RELATED TO DRINKING AND DRIVING

There is strong research evidence that demonstrates direct relationships between numbers and densities of alcohol outlets to alcohol-related motor vehicle crashes. Time series cross-sectional

panel studies examining states in the United States show that large-scale variations in outlet densities and alcohol sales are related to equally large-scale changes in rates of alcohol-related crashes (single-vehicle nighttime fatal crashes; Gruenewald, Ponicki and Holder, 1993; Gruenewald and Ponicki, 1995). These studies account for the many demographic and structural characteristics of states that are also known to be related to crash rates [e.g., age distributions and changes in the minimum legal drinking age (MLDA) and beverage taxes]. They show that for each 1% increase in outlets per population there is a proportional increase in alcohol-related crashes from roughly 0.1% to 0.4% (measuring the proportional change in crash rates relative to proportional changes in availability). Elasticity estimates of the impacts of changes in numbers and densities of outlets consistently fall within this range (reviewed in Stockwell and Gruenewald, 2004).

The small sizes of the elasticities observed in these large-scale studies seem to suggest that regulation of outlet densities may only modestly reduce crash rates in smaller community settings. This suggestion, however, runs counter to another observation about alcohol outlets; measured at smaller levels of aggregation, for example Census tracts, numbers and densities vary by two orders of magnitude or more (across California, for instance, by a factor of about 300). When viewed from the perspectives of neighborhood residents and community leaders, “small” elasticities can multiply out to big problems, thus justifying the local concern about over-concentrations of alcohol outlets.

Since researchers expect that extreme local variations in outlet densities might be accompanied by similarly extreme variations in alcohol-related motor vehicle crashes, many more local cross-sectional studies of outlets and crashes have been conducted. These studies also consistently demonstrate significant correlations between measures of the physical availability of alcohol and crashes, independent of a host of covarying local features of the community environment (Van Oers and Garretsen, 1993; Scribner et al., 1994; Giacomassi and Winn, 1995; Jewell and Brown, 1995; Gruenewald et al., 1996; Escobedo and Ortiz, 2002). Additional evidence indicates a similar correlation with pedestrian injury collisions (LaScala et al., 2000, 2001). Most recently, these relationships have been examined over time at the zip code level, showing that changes in numbers of bars and off-premise establishments are longitudinally related to changes in rates of alcohol-related crashes (Treno et al., 2006a).

ECONOMICS: HOW ARE GREATER OUTLET DENSITIES RELATED TO DRINKING AND DRIVING?

With all these data and observations in hand the obvious question to ask, of course, is “what societal mechanism relates changes in outlet densities to changes in alcohol-related crashes?” The most straight-forward response can be made within an economic framework. The costs of alcohol to consumers consists of its retail price, convenience costs entailed in its purchase (e.g., travel time), and other transaction costs related to use (e.g., credit card sales). These full costs work together to reduce use and problems (Mast et al., 1999; Laixuthai and Chaloupka, 1992). Evidence that full costs affect use and problems is the observation that the impact of each cost on use is proportional to the others. If a state makes alcohol widely available through many outlets, convenience costs are low and the proportional impact of taxes much greater (Trolldal, 2005). Alternatively, the impacts of beverage taxes on drinking and driving may decrease as penalties for drinking and driving increase (Young and Likens, 2000). In yet another example, in states

where alcohol taxes are greatest, the impacts of restrictions on access to alcohol (e.g., the MLDA) are reduced (Ponicki and Gruenewald, 2006).

This line of research indicates that the specific mix of alcohol controls can make a difference to the observed effectiveness of policies to reduce alcohol-related motor vehicle crashes. Consequently one implication of full cost theory to the application of alcohol policies for the reduction of alcohol-related traffic crashes is very important: An optimal portfolio of prevention efforts will work best to reduce the rates of this problem outcome (Caulkins, 2005; Miller and Hendrie, 2005). The criteria by which to establish “optimal” strategies will have to be set in future work and will by nature be contentious (i.e., weighing lives lost due to alcohol use against economic benefits drawn from the alcohol market). Nevertheless, this theoretical approach holds promise for establishing best practices for alcohol policy.

Despite the obvious appeal of a full-cost approach to policy makers, however, full-cost theory neglects one central concern of communities with regard to traffic safety and alcohol outlets; what may be called the “distributive costs” of alcohol outlets. Unlike full costs established across large populations of consumers, distributive costs are related not to the numbers of alcohol outlets but to their geographic distribution within communities. Concentrations of alcohol outlets in some areas, but not others, may increase or decrease alcohol-related traffic crashes in and around those areas exposing local populations to greater or lesser traffic safety risks. Both the number and placement of alcohol outlets in different areas of communities may jointly affect traffic safety, providing local opportunities for planning and zoning regulators to significantly change risks related to drinking and driving.

GEOGRAPHIC EPIDEMIOLOGY 2: WHERE ARE DRUNKEN DRIVING CRASHES MOST LIKELY TO OCCUR?

The full-cost model suggests that the impacts of alcohol availability on use and problems will be conditional upon other costs of alcohol use. At the local level it would seem that the same argument should apply, the easy availability of alcohol from the corner store trumping so-to-speak the impacts of alcohol taxes. Although a reasonable line of thinking, it is also true that other facets of the alcohol environment come into play; forces that dictate who will drink and drive and what neighborhoods will experience problems related to drinking and driving. In an examination of the microstructure of urban and suburban areas, proximity to alcohol outlets may (a) decrease drinking and driving (since drinkers have less distance to travel to obtain alcohol), (b) increase drinking (since convenience costs are reduced), and (c) alter patterns of use of outlets (since these are more or less available). In one recent study, after many other measurable facets of local environments for alcohol at the community level were taken into account, all three of these effects were found (Gruenewald et al., 2002). Greater availability of alcohol through outlets was related to (a) a decrease in drinking and driving (due to reduced distances between drinkers and outlets). But this effect was overwhelmed by (b) greater frequencies of drinking due to greater availability and (c) greater opportunities for use in risky environments (i.e., drinking at bars and restaurants). Thus, additional opportunities to drink in potentially injurious environments would appear to explain why there is an excess of traffic crashes and pedestrian motor vehicle injuries in neighborhoods with greater numbers of alcohol establishments. Due to the geographic distribution of risk exposures for crashing that confront drinking drivers as they drive away from outlets, crashes are greater in areas leading away from outlets toward residential

areas (Gruenewald et al., 1996, 2000) and that intersect with high traffic flow segments of the roadway system (Gruenewald and Treno, 2000). For this reason risks related to drinking and driving spread across neighborhoods of communities.

Looking at data from the same microlevel, Stockwell et al. (1992) have added some important detail to this evidence by examining a unique set of data regarding alcohol-related harm (assaults, road crashes, and drinking and driving offenses) and consumption (alcohol sales recorded for taxation purposes) measured at the level of individual licensed premises. They found that on-premise establishments, nightclubs, taverns, and “hotels” (large venues devoted almost entirely to drinking in Australia) were at high risk for having customers involved in drinking and driving. Measuring consumption at these places, these outlets were more likely to sell to consumers who drove after drinking. Extending these cross-sectional observations, Gruenewald et al. (1999) conducted a panel analysis of these data that detected significant relationships between the types of beverages sold at individual premises and patterns of drinking and driving offenses; increases over time in sales of higher strength (as opposed to lower strength) beers from these establishments were associated with increases in drinking and driving offenses. Using similar data from the United States, Wieczorek and Coyle (1998) have identified specific types of community neighborhoods that are more likely to produce drunken drivers (i.e., areas with larger populations of youthful, lower-educated, white males with unskilled jobs). Measuring the growth and decline in drinking and driving populations in six U.S. communities, Gruenewald et al. (2000) provide an analysis that rates of self-reported drinking and driving reported by community residents can be related to changes in rates of alcohol-related crashes elsewhere in the community, areas near to high concentrations of on-premise outlets.

Since economic forces are sufficient to result in the concentration of alcohol outlets in low-income, minority areas of communities, it is no surprise that these areas are also most vulnerable to risks related to drinking, driving, and crashing—a community-level health disparity frequently recognized by local residents. However, in the majority it does not appear that local residents are drinking at these local establishments. The catchment areas of bars and restaurants are much larger than local neighborhoods in which they are located and attract customers from areas well away from these neighborhoods. Regardless, the additional distributive costs of drinking and driving are borne by local residents living in and around areas with greater outlet densities. Greater risks of drunken driving crashes and pedestrian injury collisions arise in and around these over-concentrated neighborhoods.

SOCIOLOGY: WHAT ARE THE SOCIAL MECHANISMS THAT RELATE OUTLETS TO DRINKING AND DRIVING?

At the heart of the concerns about the impacts of alcohol outlets on traffic safety are two questions, “how do alcohol outlets enable drinking and driving?” and, more specifically, “what is it about overconcentrations of alcohol outlets that accelerate drinking and driving?” These questions are simultaneously trivial and important. Looked at one way, these questions might be viewed as hardly requiring a scientific response. If a drinker drives to an outlet and has a drink, then driving after drinking and crashing may occur on the way home. For this reason there will be many alcohol-related crashes in and around areas with greater concentrations of alcohol outlets (distributive costs). The theoretical and empirical analyses of the data just presented seem sufficient to justify regulation of outlets through the documentation of these facts.

On the other hand, a community's experience with the limited ability of lower blood alcohol concentration thresholds, extra policing and enforcement, speedier and more severe penalties for drinking and driving, higher MLDAs, and so on, to substantively reduce drunken driving suggests some limitations to our knowledge of the social processes involved in this problem behavior. The persistence of higher-than-expected rates of drinking and drunken driving leads to a more complicated set of questions. Given the risks of driving after drinking, why does anyone drink at alcohol outlets, sometimes drink too much, and thus place himself risk for drunken driving? Do alcohol outlets provide social supports for drinking and driving that go beyond simply providing opportunities to drive after drinking? Do alcohol outlets provide supports for core groups of drinking drivers who are resistant to the effects of alcohol policies, and prevention and treatment interventions?

Social Influence

Despite the fact that the studies reviewed in this paper begin to reveal some aspects of the population ecology of drinking and driving, little is known about the social mechanisms that support drinking and driving behaviors. Many psychological correlates of heavy drinking, and drinking and driving, have been studied (e.g., impulse control, time discounting, and other personality factors). In addition, a great number of demographic attributes have been used to identify populations of drinking drivers (e.g., age, gender, income). However, these studies provide only limited guidance to understanding the social processes that explain this problem behavior (see reviews in Evans, 2004). They have focused upon the individual characteristics of drinking drivers and have only partially identified the social processes of drinking as formative mechanisms for learning to drink and drive, or as supportive mechanisms for drinking and driving. As a central example, peer influence is identified as a process by which an individual's attitudes, beliefs, and expectations about drinking and drinking and driving are formed (or influenced), but the environmental contexts of these societal influences receives little recognition in social developmental models of drinking and driving. In light of this, an important question to ask is "where do these influences take place?"

The Primacy of Local Context

Another way of asking this question is to ask, "where does peer influence take place?" The obvious answer is not that peer influence is projected through the public media (say through media representations of drinking, though there is some very slight evidence of such media effects). Rather, very essentially, peer influence is projected through direct contacts of young people with their peers in specific contexts. The evidence that small group processes affect likelihoods that any behavior will take place (including behaviors quite contrary to "reason" like the administration of electrical shocks to others) is overwhelming. With specific regard to alcohol use, the same evidence among drinkers is also overwhelming (Collins and Marlatt, 1985). Drinkers model one another's behaviors in social contexts, drinking more or less as others drink more or less (Duncan, et al., 2005). Presumably, repeated opportunities to model drinking behaviors of others dominates the drinking experiences of young people who will likely come to use alcohol and, presumably, repeated participation in social groups that drink reinforces most drinking behaviors among adults. These may well include problem behaviors like drinking and driving.

The Primacy of Selection

If young people who are learning to drink, and adults who are at risk for drinking and driving, are being influenced by the peers they meet in local contexts, the important related question to ask is “how do these people come to be in these contexts?” Do young people consciously choose the contexts in which they are exposed to drinking? Or do they find themselves in certain contexts in the pursuit of other personal objectives (e.g., at parties or dating)? Do adults consciously choose to drink in at-risk contexts (e.g., bars)? Or do they find themselves in contexts in the pursuit of other personal objectives (e.g., social contacts)? Based on the very fragmentary empirical analyses currently available both selection and influence appear to play a part in learning to drink and choices of places to drink. For example, it appears that expectations about drinking outcomes are both highly context specific (Goldman and Darkes, 2004), affect drinking patterns (Chen et al., 1994), and are in turn affected by experiences of drinking (again in different contexts, Darkes et al., 2004). Selection of places to drink are strongly correlated with drinking patterns (at least in adults; Gruenewald et al., 2000*b*) and specific personality characteristics of drinkers (again in adults; hostility and aggression associated with drinking at bars; Treno et al., 2006*b*). Perhaps drinkers assort themselves across drinking contexts based upon opportunities to drink (e.g., availability) and the concordance of these environments with their expectations about drinking (including supports for problem behaviors associated with use, like violence and drunken driving)?

Four Core Components of a Theoretical Framework for the Social Dynamics of Drinking

Current efforts to understand the ecology of drinking behavior have made it quite evident that stronger mathematical analyses of the fundamental patterns of interaction between drinkers and their drinking environments are needed (Gorman et al., 2006; Sanchez et al., 2006). Drawing upon systems dynamic and agent-based modeling perspectives (Holder, 1998; Gilbert and Troitzsch, 1999; Hedstrom and Swedberg, 1998), four essential theoretical components of ecological models emerge as requirements for an adequate ecological theory of drinking and drunken driving:

1. **Agency.** Drinkers are agents who pursue alcohol in their environments and select places to drink in concordance with drinking experiences and expectations. Drinking places are preferred that are in concordance with drinkers’ expectations about appropriate use and social behaviors in these contexts.
2. **Contexts.** Specific environments provide opportunities for drinking that match drinkers experiences and expectations and expose them to social influences for related problem behaviors. In the alcohol market commercial contexts compete with one another for market segments of drinkers.
3. **Contacts.** Populations differentially contact and mix with one another in these contexts providing opportunities for social influence (social modeling that shapes expectations).
4. **Topology.** Geographic and other network distributions of physical and social contexts for drinking affect contacts with other drinkers (and the social influences that an agent will experience).

With these concepts in place it is possible to construct dynamic models of drinking and driving appropriate to the explanation of individual and population patterns observed in the natural world of the drinking driver. The notion of “agency” will include attributes of the individual that can lead her to poorly assess risks related to driving when intoxicated (e.g., time discounting) or that lead her for other reasons into high-risk drinking activities (e.g., eating dinner with her date at a restaurant). The notion of “contexts” will include those facets of the social and physical environments that enable drinking opportunities when driving is likely (e.g., a network of friends who drink at one another’s homes or bars frequented by other similar drinkers). The notion of “contacts” will include those social environments in which individuals make contacts with others who support drinking and driving (or, complementarily, do not censor drinking and driving). The notion of “topology” will include characterizations of transportation networks and geographic distributions of places where social and physical opportunities to drink incur different full costs.

THEORETICAL INTEGRATION: A DUAL POPULATION MODEL OF DRINKING AND DRIVING

In order to understand the full impacts of outlet densities and locations upon traffic safety it is essential to develop theoretically integrated approaches that adequately connect what is known about individuals at-risk for drinking and driving with what is known about the ecologies of drinking places, traffic crashes, and injury events. Since driving is very prevalent in U.S. society and very many drinkers drive after drinking at some time it may be of value to pursue this theoretical integration with the idea that there are two “iconic” kinds of drinking drivers. Defined at the extreme poles of this behavior, one group would be composed of those drinkers who occasionally drive after drinking (and only sometimes after drinking too much) and a second group composed of those drinkers who repeatedly drive after drinking (and often after drinking too much). Recognizing that there is a continuous gradation of behaviors between these two extremes, the two different groups of drinking drivers will be characterized in very different ways across the four core components of the proposed theoretical framework:

1. **Agency.** The repeat drinking driver will exhibit specific personality correlates related to the acceptance of high-risk behaviors in general (e.g., time discounting, poor impulse control, high sociability). The occasional drinking driver will be within the normal range of these personality correlates.
2. **Contexts.** Due to the smaller size of this high-risk population, the repeat drinking driver will select rather specific social and physical contexts in which to drink that are frequented by similar others (identified by the personality characteristics noted above). The occasional drinking driver will select broader social and physical contexts in which to drink, many of which may be unrelated to drinking as a central activity per se (e.g., drinking at restaurants). The repeat drinking driver will drink frequently, but at a relatively small number of drinking places. The occasional drinking driver will drink less frequently, but at a greater diversity of drinking places.
3. **Contacts.** The repeat drinking driver will tend to drink in places where she is likely to meet similar others and, therefore, is unlikely to meet others who either drink less or are less likely to drive after drinking. The occasional drinking driver will tend to drink in many different places where she will make contact with other drinkers who drink less and more and who are

more and less likely to drive after drinking. In this way the occasional drinking driver forms a social bridge between those drinkers who may be predisposed to drive after drinking and those contexts which strongly support this problem behavior. Youthful drinkers, or those drinkers newly arrived in a community, sample from broader networks of contacts than others, selecting environments that are in concordance with their drinking expectations.

4. **Topology.** Since the social objectives pursued by occasional drinking drivers are quite diverse, and the social objectives pursued by repeat drinking drivers rather narrow, the geographic distribution of drinking places will be more clustered for repeat drinking drivers. The social stratification processes that enable repeat drinking drivers to find social supports for this behavior will be reflected in an accompanying narrowing of the distribution of places where drinking takes place.

As this theoretical approach suggests, there will be a progressive narrowing of drinking contexts for the young, potential repeat, drinking driver as she grows into a mature drinking pattern. At first many contexts will be sampled; those contexts where contacts reinforce expectations about outcomes of drinking will be preferentially selected and, eventually, as drinking and driving after drinking continue, these contexts will narrow to only places where this behavior is accepted and supported. Mathematical analyses of similar social processes with regard to heavy drinking (among college students) suggest that problem drinkers will tend toward environments that shield them from others in the drinking population, thus helping maintain these problem behaviors in college settings (Mubayi et al., 2006). These social processes serve a net benefit to the larger population (because influences across contexts are reduced), but also insulates the repeat drinking driver from broader influences that might mitigate the problem behavior, providing one reason why drunken driving is so persistent in its course.

CONCLUSION: TOWARD EFFECTIVE REGULATORY POLICIES

Although progress has been made toward understanding the relationships between alcohol outlet densities and traffic crashes, much more work needs to be accomplished along two fronts: (a) topological issues regarding the distributions of alcohol outlets across community environments and (b) examinations of social mechanisms that continue to support drunken driving in community settings. With regard to topological issues, several interesting questions arise with regard to the licensing and regulation of alcohol outlets. Primary among these is the relative contribution of outlet numbers versus outlet densities and distributions to traffic-related injuries and death. Current research is sufficient to indicate that numbers, densities, and distributions collectively matter, but the separate contributions of these aspects of outlet location to traffic safety are not well understood. As reviewed in this paper, current research indicates that over-concentrations may be a particular problem, focusing crashes within select neighborhoods of communities and confronting residents with unusually high traffic safety risks. However, considering the overall traffic safety burden of alcohol outlets to communities as wholes, no research studies have indicated that outlet concentrations per se contribute to traffic safety risks beyond those associated with numbers of outlets. While an apparent fine point in the study of outlets and alcohol problems, this distinction has very different implications for regulatory strategies: regulate the number of outlets across the community regardless of distribution

(overconcentrations do not matter) versus regulate outlet concentrations to reduce the number of outlets in highly concentrated areas (overconcentrations are a key to the problem). With regard to the social mechanisms that support drinking and drunken driving, it is essential to begin to explore the degree to which the theoretically proposed social mechanisms insure a continuing population of at-risk drinking drivers within drinking communities. Researchers must identify the roles that alcohol outlets play in providing particular at-risk environments which cultivate and support driving after drinking and drunken driving. Understanding these social mechanisms will be essential to further progress in reducing these problems related to alcohol use.

At this juncture in the development of research in this area, however, the evidence is sufficient to justify two specific recommendations with regard regulations on outlet numbers and densities that will enable communities to reduce drinking and driving and crash risks related to drunken driving:

1. Regulate alcohol outlet densities by distance rather than population. Population density regulations establish upper limits on outlet growth that, especially in growing urban populations, allows numbers of outlets to concentrate in specific urban neighborhoods. These population regulations put a cap on the number of outlets in a community but do not restrict the geographic distribution and location of outlets, enabling the overconcentration of outlets and associated problems in specific urban neighborhoods (usually low-income minority areas). Distance regulations detach density restrictions from population growth, providing a well defined (and metrically appropriate) boundary on availability.

2. Locate alcohol outlets in low traffic flow areas where the immediate impacts of driving under the influence crashes are moderated. Much of the traffic safety literature demonstrates that areas with high traffic volume and speeds, and where negotiating lane changes and curves demands more of the driver, are at high risk for motor vehicle crashes. These are also the places in communities where many alcohol-related crashes occur. Although much more needs to be done to help communities establish best locations for alcohol outlets, placing alcohol outlets in locations where drunken drivers must negotiate fewer difficult driving situations seem well-advised. Even though overall rates of driving after drinking might not be directly affected, the guiding principle for planning and zoning appears to be to minimize crash risks. These risks are aggravated by placing outlets in locations where intoxicated drivers must negotiate more challenging traffic conditions (e.g., near to highway on-ramps). These risks can be minimized through thoughtful licensing practices.

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Limits on Hours of Sales and Service *Effects on Traffic Safety*

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The relationship among physical availability of alcohol, alcohol consumption, and alcohol-related problems is multifaceted and complex (Ashley and Rankin, 1988; Giesbrecht and Greenfield, 2003; Grube and Stewart, 2004; Skog, 2003). Availability theory posits that alcohol availability influences consumption levels, which influence alcohol problem levels, such as rates of impaired driving and alcohol-related crashes, in a population. The availability theory approach to alcohol problems is predicated on the assumption that alcohol problems can be reduced by lowering the amount of alcohol consumed in society (Anatalova and Martinic, 2005; Chikritzhs and Stockwell, 1997; Grube and Stewart; Ragnarsdóttir et al., 2002; Rush et al., 1986). Alcohol control policies are one such set of “public health measures” that governments, agencies, or industry can implement to reduce per capita consumption. This essentially occurs through the imposition of various “barriers” that control consumer–product interaction (Ashley and Rankin, 1988). Thus, the rationale behind availability theory underlies restrictions on hours of sale or service for which alcohol may be sold for off-premise and on-premise consumption (Anatalova and Martinic, 2005).

However, availability theory is not the only conceptual framework that has been used to inform alcohol control policies. For on-premise consumption, “power drinking,” “last call,” or “six o’clock swill” has been suggested as a competing hypothesis (Chikritzhs and Stockwell, 2002; Foster, 2003; Grube and Stewart, 2003; Room, 1988; Ragnarsdóttir et al., 2002). This hypothesis suggests that tight restrictions on closing times lead to great numbers of drinkers consuming as much alcohol as possible at last call for the service of alcohol, shortly before the licensed establishment closes. This means increased blood alcohol concentrations (BACs) of patrons as they imbibe large amounts of alcohol (power drinking) over a short time period. These crowds of patrons leaving licensed establishments at closing times then become involved in increased levels of intentional and unintentional injuries and other types of damage. This hypothesis has often been cited as evidence that closing hours of licensed establishments should be less restricted as a way to reduce alcohol-related problems (Chikritzhs and Stockwell, 2002; Ragnarsdóttir et al., 2002).

THE EVIDENCE

Research on hours and days of sale or service is limited, especially in relation to traffic safety measures. It is noteworthy that few published North American studies have specifically evaluated this alcohol control measure. Yet, Smart (1980) has noted that legislators manipulate days and hours of sale or service more than any other control measure. Indeed, various jurisdictions have recently reviewed extended drinking hours policies (e.g., Drummond, 2000; Institute of Alcohol Studies, 2003; Jang, 2002; Strategic Task Force on Alcohol, 2002). Most studies have been conducted in Europe or Australia. Also noteworthy is that very few studies are methodologically sound. Major problems include the use of pre-experimental, pre-post designs;

uncontrolled confounders, such as concurrent interventions; and the limited use of time series analyses. Thus, great caution should be taken in interpreting the results.

Off-Premise Sale

The restriction of hours of sale of alcohol for off-premise consumption is a commonly used method to control alcohol consumption and harms. The approach is often used within the context of state monopolies of alcohol sale, but it has also been used by other regions with less restrictive policies (Anatalova and Martinic, 2005). Interestingly, countries with retail monopolies generally demonstrate slightly lower per capita consumption than countries with unrestricted alcohol sales (Anatalova and Martinic, 2005).

Various studies from the Nordic countries on the effects of hours of alcohol sales demonstrate a variety of complex effects. The majority has examined reduction of hours and one has examined extension of hours. Makela, Rossow, and Tryggvesson (2002) review a number of studies conducted in Finland, Norway, and Sweden when they independently engaged in Saturday closing of alcohol outlet stores in the 1970s to 1980s. Finland implemented the closings in several trials. During the first trial, there was a slight decrease in alcohol consumption, a decrease in sales through monopoly stores, an increase in sales of medium strength beer in grocery sales, and no effect of on-premise sales of other alcoholic beverages. Arrests for public drunkenness increased owing to simultaneous increase of police activity. For the second trial, although total alcohol sales were 3% smaller than expected, there were no effects found on illegal production or black market sales, alcohol-related arrests, or drunk driving. However, changes in collision rates were not mentioned. In Norway, the various assessments that were conducted found that there was virtually no effect on alcohol consumption or alcohol-related harm, although some effect was found for a group with heavy drinking problems in that public drunkenness and admissions to detoxification centers declined on Saturdays and Sundays. The Saturday closings resulted in customers purchasing greater quantities of alcohol on fewer occasions; thus the effect of alcohol sales was negligible. In Sweden, Olsson and Wikstrom (1982) studied the effects of experimental Saturday closing of liquor retail stores. A comparison of the data from the summer of 1980 with the summer of 1981, when the experimental legislation was introduced, showed that alcohol sales declined by 8%, the number of intoxicated, detained persons declined by 11%, and the number of police interventions for domestic disturbances reduced by 15%. Data on impaired driving charges and alcohol-related crashes were not available.

An Australian study examined the effect of restriction of hours of sale in a small predominantly Aboriginal community on alcohol consumption, incidence of crime, and outpatient hospital data (Douglas, 1998). A decrease in alcohol consumption, alcohol-related presentations to the hospital was found, but a variety of concurrent programs to promote health were also on-going, which place limitations on the conclusions.

Most recently one study was conducted on extending opening hours. Norström and Skog (2005) examined a trial with Saturday opening of alcohol retail shops in certain parts of Sweden (February 2000, phase I), which was extended to the whole country (July 2001, phase II). In phase I, stores in an experimental area (six counties) were open on Saturdays. In the control area (seven counties) the shops remained closed. To prevent biases due to trade leakage, the experimental and control areas were separated by a buffer area (seven counties). Because continuous evaluations of phase I did not show any negative effects, the Saturday opening was

implemented in all of Sweden after 17 months. The outcome measures included alcohol sales and measures of assaults and drunk driving. For phase I, the pre-intervention period was January 1995 to January 2000 and the post-intervention period was February 2000 to June 2001 (17 months). Phase II was July 2001 to July 2002 (13 months). Monthly data were subjected to ARIMA modeling whereby sales and harm rates in the experimental area were compared to the control area during phase I as well as during phase II. Statistically significant increases of 3.7% during phase I, and of 3.7% during phase II was found in alcohol sales. No significant changes in any of the assault indicators, were found during phases I or II. Although there was a statistically significant increase in drunk driving (12%) during phase I, but not during phase II, the analyses suggested that the increase was mainly due to a change in the surveillance strategy of the police. Thus the study found evidence of increased alcohol consumption but not alcohol-related harm. However, the authors questioned whether the results were due to insufficient statistical power, together with some other methodological challenges.

One U.S. study examined the incidences of driving under the influence (DUI) by day of week for Athens, Georgia, where alcohol was not permitted to be sold between 11:45 p.m. on Saturday and 7:00 a.m. on Monday. Daily tabulations of DUI were aggregated over a 2-year period (March 1986 to February 1988) (Ligon and Thyer, 1993). Chi² analysis found an overall main effect, while multiple chi² tests corrected for the number of tests performed, found that the frequency of DUI arrests made on Sunday were significantly lower than for all days except Monday. Unfortunately lack of a comparison jurisdiction and other methodological challenges prevents a causal attribution from being made between the Sunday alcohol sales ban and DUI arrest rates.

In summary, the results reflect a complex pattern of effects on alcohol purchase, consumption, and harms although no study investigated impact of off-premise sales on road crashes. Moreover, the methodological and statistical weaknesses of a number of studies limit the strength of the conclusions that can be drawn from the studies.

On-Premise Consumption

Regulation of hours of sale or service of alcohol for establishments licensed for on-premise consumption is also commonly used to control alcohol consumption and harms. Two studies were found that examined the effect of restricting extensions to permitted licensing. The remaining studies investigated the extension of days or hours of sale or service in licensed establishments.

Graham, McLeod, and Steedman (1998) examined the effect of restricting extensions to permitted licensing hours on the incidence of alcohol or assault-related presentations to an inner city emergency department in the United Kingdom. Prospective data were collected on emergency department presentations between 1700 and 0900 h 2 weeks before the introduction of the restriction, 2 weeks immediately after the restriction, and 5 weeks after the restriction. Over 56% provided a breath sample and 28.9% were positive. The majority of assault cases who were tested were alcohol positive but no significant pattern of alcohol or assault-related presentations followed the restrictions. However, the study suffered from a number of methodological limitations such as lack of a concurrent control group.

Voas et al. (2002) examined the effect of a partial sales ban on cross-border drinking in Mexico where, on January 1, 1999, Juarez, Mexico, implemented a 2 a.m. bar closing from the previous 5 a.m. closing time. The study found that at the Juarez–El Paso border crossing, the

total number of youths crossing from Juarez who were BAC positive after 3 a.m. when the bars closed, decreased by 89% while no comparable change was found between 12 to 3 a.m. The study did not formally examine road safety measures, although they did examine local trauma data from an El Paso hospital. They found that in 1998, the year before the policy change, 35% of motor vehicle crash admissions involved alcohol, which dropped significantly to 26% in 1999. However, time of day or day of week were not available and the authors indicate that this reduction cannot directly be attributed to the new bar closing restrictions in Juarez.

A series of studies on the effects of increased hours of sale of alcoholic beverages in various cities and states of Australia have been reported by Smith. The increased days and hours were due to early openings (Smith, 1986), the introduction of Sunday alcohol sales in the cities of Perth and Brisbane (Smith, 1978, 1988*a*), and in the state of New South Wales (Smith, 1987), the extension of hotel closings from 6 to 10 p.m. in Victoria (Smith 1988*b*) and from two 2-h sections on Sunday to an 8-h section in Victoria (Smith, 1990), and the introduction of flexible trading hours [which permitted hotels to stay open later than the previous 10 p.m. closing time in Tasmania (Smith 1988*c*)]. In all these instances, significant increases in either fatal or injury-producing crashes were observed in the years in which alcohol became more available in comparison with previous years, control times periods or control areas where no changes were introduced. However, a number of methodological and statistical problems preclude firm conclusions being drawn from these studies. For example, in the Brisbane study (Smith 1988*a*), the peak hours for crashes changed according to changes in opening hours, but the overall rate of crashes did not increase and since no information was available on BACs of drivers involved in crashes, it is difficult to interpret the findings. The increased crashes could simply be due to more people on the road, rather than to impaired driving. In addition, the author had to contend with a number of confounders, such as the simultaneous introduction of other alcohol control policies such as the reduction of the maximum blood alcohol level from .08% to .05%, and the extending of evening hours drinking and Sunday drinking. Moreover, the data were subjected to simple pre-post χ^2 tests, and not time series analyses, thus limiting the interpretation of the findings (Posavac and Carey, 1997).

More recently evaluations of the public health and safety impact of extended trading permit hours were conducted in Perth, Australia (Chikritzhs, Stockwell, and Masters, 1997; Chikritzhs and Stockwell, 2002). The extended trading permit hours were granted to some but not all applicants. The permit allowed an additional hour of serving alcohol, typically at peak times, such as early on Saturday or Sunday. Chikritzhs et al. (1997) conducted a study of 20 pairs of hotels matched on levels of assault prior to the introduction of late trading and wholesale purchase of alcohol in Perth between 1991 and 1995. Half of the hotels received extended drinking hours permits in 1993 to 1994. Levels of monthly assaults more than doubled in hotels that had received extended hours permits compared to no changes in hotels with normal hours. However, no significant increases in road crashes were found related to the extended trading permits. A subsequent evaluation (Chikritzhs and Stockwell, 2002) examined the impact of extended trading hours on levels of violent assaults on or near licensed establishments between 1991 and 1997. They found significant increases in monthly assault rates for hotels with extended trading permits after the introduction of extended trading hours. This relationship was mostly accounted for by increased volumes of alcohol purchase by late trading hotels. However, changes in motor vehicle collisions were not studied.

Two studies were conducted in Scotland to evaluate the effects of changes in liquor licensing arrangements. These were introduced in 1976–1977 and included the extension of

drinking in public bars from 10 to 11 p.m., Sunday bar openings, and the addition of “all day licenses” which were regular extensions of permitted hours. Duffy and Plant (1986) plotted relative risk time series from 1970 to 1985 for mortality from liver cirrhosis, from alcohol dependence and total alcohol related mortality, hospital admissions for alcohol dependence, drunkenness, and drunk driving convictions but did not subject them to any statistical analyses. The authors report that “the study showed no appreciable effect on the level of alcohol-related morbidity and mortality, although some improvements were noted in relation to the rates of convictions for drunkenness” (p. 36). Evaluating the same liberalization of the liquor licensing laws, Northridge, McMurray and Lawson (1986), analyzing data on 2,868 consecutive patients admitted for self-poisoning (drug overdoses) between 1971 and 1982, found significant increases in the frequency of alcohol taken in association with self-poisoning with the relaxation of the liquor licensing laws. However, the lack of comparison groups and time series analyses preclude firm conclusions being drawn from the findings.

A more recent study of extended drinking hours was conducted in Reykjavík, Iceland (Ragnarsdóttir et al., 2002). Until 1999, drinking hours in licensed establishments ended at 2 a.m. on weekends and 11:30 p.m. on weekdays. However, the crowds of people leaving licensed establishments at closing time created congestion and other problems like injuries due to falls or assaults. In 1998, the Icelandic alcohol law was revised to allow unrestricted alcohol serving hours to reduce these problems. The evaluation consisted of (a) police statistics; (b) a telephone survey of all 33 proprietors of licensed establishments; (c) interviews with representatives of city center inhabitants, street sweepers, restaurant inspectors, and night life participants; and (d) two field visits. The evaluation was conducted during eight weekends of March and April in 1999 and compared with eight weekends of March and April 2000. The results indicated pre-post increase of 14% in city center police calls compared to overall police call increase of 6%. Admission to the emergency ward increased by 20% for the weekends but decreased by 2% for week days; intentional and unintentional injuries to the emergency ward also increased by 34% and 23%, respectively. According to police reports, the number of cases of suspected drunk driving increased by 80%. However, the authors note the time, statistical, and methodological limitations but suggest that the data give rise to further questions regarding the impact of extended drinking hours.

Because of the methodological and statistical limitations of the studies cited above, we have limited information on the road safety impact of extended drinking hours in licensed establishments. Furthermore, because of the age of many of these studies and the cultural differences between these countries and North America, (for example, the unique system of distribution of alcohol in licensed establishments of on-premise and off-premise trading that exists in Australian jurisdictions) the generalizability of the results is difficult to assess.

However, recently two studies have been conducted in Ontario (ON), Canada, after the closing hours for licensed establishments were extended from 1 to 2 a.m. on May 1, 1996. Vingilis and colleagues examined the impact of extended drinking hours on Ontario as a whole and on the cross-border cities of Windsor and Detroit. The purpose of the first study was to evaluate the overall effect in ON (Vingilis et al., 2005a,b). Three competing hypotheses were tested: (a) alcohol availability, (b) “power drinking,” and (c) temporal shift in drinking. (This hypothesis posited that the amount of consumption will stay the same because patrons will stay at licensed establishments the same length of time. Rather patrons will shift their hours of patronage.) This study used a multimethods, multiple measures elaboration design that included both implementation and outcome evaluation measures. Implementation was evaluated by a

questionnaire sent to a random sample of licensed establishments in ON. A quasi-experimental design using interrupted time series with a nonequivalent, no-intervention control group was used to assess changes. The analyzed data sets were total and alcohol-related, monthly, traffic fatalities for ON, for the 11 to 12 p.m., 12 to 1 a.m., 1 to 2 a.m., and 2 to 3 a.m. time windows, for Sunday through Wednesday nights and for Thursday through Saturday nights, for 4 years pre-policy change and 3 years post-policy change, compared to neighboring regions of New York and Michigan (NY–MI). Time series analyses of total and BAC positive ON and NY–MI driver fatality data aggregated over the 11 p.m. to 4 a.m. time periods indicated no significant changes for Sunday through Wednesday and Thursday through Saturday groups for total driver fatalities for both ON and NY–MI data. For BAC-positive monthly pre-post driver fatalities, near significant downward trends were observed for ON data for both Sunday through Wednesday and Thursday through Saturday groups, while a significant downward trend was observed for the NY–MI data for Thursday through Saturday. For Sunday through Wednesday significant downward trends occurred for 1 to 2 a.m. for BAC-positive and for total driver fatalities in ON, while no changes occurred for the NY–MI data. For Thursday through Saturday no significant trends were found for ON BAC-positive and total driver fatalities while NY–MI BAC-positive driver fatalities showed a significant downward trend for the 2 to 3 a.m. time window.

The survey data suggested limited implementation, although the response rate was low. Less than half (49.56%) of the respondents indicated that they had changed their hours since the amendment to the extend hour of service. Of those who changed their hours, 31.7% indicated that their closing hours shifted from 1 to 2 a.m. for all days of the week, 26.6% indicated that their closing hours shifted from 1 to 2 a.m. for Thursday through Saturday only, and 41.59% changed their hours in other ways, such as shifting of hours, shorter hours, and various combinations of openings throughout the whole week. Of the 17% of licensed establishments most likely to stay open late, bars and taverns (about 45%) were open until 2 a.m. Sunday through Wednesday nights and two thirds reported being open until 2 a.m. Thursday through Saturday nights.

The multiple datasets converged in suggesting little impact on BAC-positive fatalities with extension of the closing hours, possibly because of the limited implementation of the policy, and other societal factors such as economic conditions and road safety countermeasures. Yet, interestingly, for Sunday through Wednesday nights, the pre-amendment 12 to 2 a.m. peaks for BAC-positive driver fatalities seems to have shifted to 2 to 4 a.m. post-amendment, while for Thursday through Saturday the 11 p.m. to 12 a.m. and 1 to 2 a.m. pre-amendment peaks seem to have decreased and flattened out over the 11 p.m. to 4 a.m. time periods. These different distributions could suggest different patterns of drinking for week days and weekends by patrons of licensed establishments and a complex effect whereby the new 2 to 4 a.m. peak for BAC-positive driver fatalities during Sunday through Wednesday could represent problem drinkers who drink until closing hours, while the weekend flattened trend could represent social drinkers who go out for short drinking episodes and may shift their drinking hours temporally over the extra hour. A subsequent study (Vingilis et al., 2006) examined cross-border drinking patterns between Windsor, Ontario, and Detroit, Michigan, in relation to the extended hours policy as one governmental rationale for extending the drinking hours was to “help the tourism and convention industry and the hospitality industry, which loses business when patrons go over the border into New York or Michigan and into Manitoba or Quebec, when Ontario bars and restaurants close” (The Honourable Norman Sterling, Minister of Consumer and Commercial Relations, 1996). This amendment made the 2 a.m. closing hour consistent with the cross-border jurisdiction of

Michigan. This study examined patterns in total and alcohol-related casualties in: (a) Windsor, Ontario, compared to Detroit, Michigan, with a 2 a.m. closing time, and (b) Ontario compared to Michigan for overall trends. The criterion outcome indicators were (a) monthly motor vehicle casualties (major injuries and fatalities) for the city regions of Windsor and Detroit and (b) Ontario and Michigan monthly motor vehicle fatalities occurring between 11 p.m. and 3 a.m. for 4 years pre-policy change and 3 years post-policy change. In order to examine cross-border drinking consequences, data were disaggregated to assess trends of motor vehicle injury collisions involving vehicles with U.S. license plates and with U.S. drivers aged 16 to 20 in the Windsor region; similarly, trends were assessed for motor vehicle injury collisions involving vehicles with Ontario license plates in the Detroit region. The Windsor region total motor vehicle casualty data showed a nonsignificant pre-post increase, while the Detroit region showed a statistically significant decrease for total motor vehicle casualties. In the Windsor region, a significant increase was found for alcohol-related motor vehicle casualties after the drinking hours were extended. However, the Detroit region showed a statistically significant decrease in alcohol-related motor vehicle casualties concomitant with Ontario's drinking hour extension. No similar trends were found for the province of Ontario and the state of Michigan as a whole. Moreover, a significant decrease was found for injury collisions involving vehicles with Ontario license plates in the Detroit region but no similar pattern was found for injury collisions involving vehicles with U.S. license plates and with 16- to 20-year-old U.S. drivers in the Windsor region. These data seem to support a cross-border impact of the Ontario extended drinking policy. A significant increase in alcohol-related motor vehicle casualties was found in the Windsor region and concomitantly, significant decreases in total and alcohol-related motor vehicle casualties were found in the Detroit region after the extended drinking hours amendment. The Ontario government's belief that the extended drinking hour policy would "reduce the number of patrons who cross the border when Ontario's bars and restaurants close" may have been realized.

DISCUSSION OF STUDIES

In summary, the literature on changes in hours or days of sale or service seems to find a variety of complex effects. As many scholars indicate, gross-level methods, such as availability controls, may not be sufficient by themselves to significantly affect consumption and harms (Antalova and Martinic, 2005). Availability theory literature indicates that factors affecting aggregate alcohol consumption are strongly related to availability factors only when other conditions remain unchanged (Antalova and Martinic, 2005; Room et al., 2002; Skog, 1990, 2002). Availability factors are mediated by a host of other factors, such as prevailing drinking practices, the role of alcohol in a given society and other cultural, political and legal norms (Antalova and Martinic, 2005). For example, Simpura (1995) has described the trends of alcohol consumption and has demonstrated that while differences among European countries are still large, a "process of homogenization is slowly proceeding in the EU [European Union]," whereby consumption has been decreasing in high consuming countries and the reverse has been occurring in low consuming countries. He argues that homogenization amongst countries has been occurring not only as a consequence of economic or health policies but also as "a symbolic battlefield on new social and cultural order." As another example, U.S. college youth seem to be heavier drinkers than Canadian college youth despite the fact that alcohol is legally available to 18- to 20-year-old

Canadians while not legally available to this age group of U.S. youth. Kuo et al. (2002), comparing college alcohol use in Canada and the United States, found that prevalence of lifetime and past-year alcohol use was significantly higher among Canadian students (legal drinkers) than U.S. students (illegal drinkers) but the prevalence of heavy drinking (consuming five or more drinks in a row) was significantly higher for U.S. students than Canadian students.

Overall, the majority of studies suggest that alcohol consumption can change somewhat in the expected direction with restricting or extending the hours of sales or service of alcohol, although variations exist. Omnibus studies of larger jurisdictions are less likely to find clear differences, while localized studies, where there seems to be additionally a high density of licensed establishments (e.g., Chikritzhs, Stockwell, and Masters, 1997; Chikritzhs and Stockwell, 2002; Ragnarsdóttir et al., 2002; Vingilis et al., 2006; Voas et al., 2002), seem to be more likely to find changes in consumption or harms. However, the better the methodology of the study, the less likelihood of finding significant results in the expected directions. That said no study was immune from methodological challenges, ranging from statistical power issues to concomitant public health interventions. Additionally, few studies examined the effects of changes in sales or service of alcohol on traffic safety. In the studies that did examine traffic safety, few significant changes were found in the expected directions that could be directly attributed to the policy change. The reasons may be related to methodological or measurement problems. Crashes are rare events and they may be too insensitive a measure to detect changes. Impaired driving offenses, on the other hand, are directly related to the degree of police surveillance that occurs and pre-post changes in surveillance can be a confounder that affects impaired driving offence rates. Moreover, generally speaking, changes in hours and days do not tend to be dramatic changes which would also limit the ability to detect a large effect. Thus, it is not surprising that evidence on the effectiveness of limitations on physical accessibility to alcohol through limits of hours of sale or service is mixed. As Room et al. (2002) write, “effects of smaller changes in availability seem more variable, and often negligible in terms of the effects on total consumption” (p.167).

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The Effects of Establishing Closing Hours in Juárez, Mexico

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The focus of this workshop is on alcohol regulation. There is substantial evidence that the conditions under which alcohol is sold or provided can influence the extent to which individuals drink to intoxication and combine drinking with high-risk activities such as driving (McKnight, 1993; Saltz, 1997; Saltz and Stanghetta, 1997; Toomey et al., 1998; Holder et al., 1993). Three broad categories of party or drinking environments can be distinguished on the basis of the extent of risk that consumers will experience alcohol-related problems:

1. Events at licensed drinking establishments such as restaurants and bars that conform to the state alcoholic beverage sales laws and minimum legal drinking age laws and that implement responsible beverage service practices. Such venues can be classified as moderate-risk locations.

2. Events at licensed establishments that do not conform to laws and responsible service practices. In most communities, a small proportion of the licensed outlets fail to follow the law or adopt appropriate safety procedures. Such outlets fail to “card” young-looking patrons and feature low-price promotions such as happy hours, which are likely to increase consumption. Thus, such venues are high-risk locations.

Both categories 1 and 2 can be considered “community” outlets in that they are generally influenced by community values as expressed by their clientele and will generally avoid practices that will attract censure and stimulate community action to call for enforcement intervention.

3. Drinking events that occur on private premises or in public locations away (or hidden) from the community and its law enforcement arm. Examples of such events are high-school keg parties at private homes when the parents are absent or in fraternity house basements. Such venues are very high risk because there generally are no provisions for limiting consumption or risky behavior such as driving after drinking.

Category 3 venues are very high risk because of three factors:

1. Alcohol is available ad lib—generally, all you can drink once admitted to the function. This produces pressure for heavy consumption to “get your money’s worth” or to take advantage of the free booze.

2. There is a lack of formal controls, which reflect community norms, and adult, organizational, and enforcement authority figures are absent. Either no one is in charge of the premises or those in charge tolerate drunken behavior.

3. Drinkers who seek such venues tend to be heavy consumers and risk-takers [such as those who report driving after drinking and drug use (Clapp et al., 2003; Shillington and Clapp,

2001; Clapp and Shillington, 2001, Lange and Voas, 2000)], so there is strong peer support for heavy drinking.

TIME-OUT CONCEPT

Attendees at category 3 events are essentially circumventing legal controls over alcohol sales and service. They are also away from community normative controls, as no individual or group has sufficient authority to enforce community drinking standards and the attendees represent a minority element that rejects community standards in favor of their personal motivation to get drunk. Following MacAndrew and Edgerton (1969) and Clark (1981), we have labeled such drinking venues as time-out events. As applied by those investigators, the time-out concept referred to the need for individuals to have a period for expressing legitimate deviance (Listiak, 1974). In our usage, no claim is made that the need is legitimate; however, the concept that groups with little opportunity to participate in some highly coveted behavior will seek opportunities to get away from restricting barriers appears to be appropriate to many of those attending category 3 events. It fits with the rationalizations of individuals who attempt to legitimize participation on the basis that it is not representative of their true character but just a brief time-out from the pressure of conforming to social norms.

Studying the venues in category 3 is very difficult because they tend to be unscheduled and away from locations where authority figures (parents, teachers, employers, and police officers) are likely to be present. Thus, it is difficult to intercept and recruit survey participants at the time they are attending such events. A unique opportunity to study such venues is provided by U.S. youth aged 18 to 30 who cross the border at almost every location along the Mexican and Canadian borders to binge drink. The opportunity is provided because, upon leaving the country in the early evening and upon returning in the early morning hours following a night of drinking, the participants must pass through a confined border location where it is possible to approach them and request an interview.

That at least a modified time-out concept is applicable to border crossers is provided by our late-night, weekend border surveys and our telephone surveys of youth in San Diego County, which indicate that up to half the youth crossing into Mexico intend to get drunk and are attracted to the cross-border bars so they can relax and “let it all hang out” because they are away from the restraints of parents, school administrators, employers, and the neighborhood police in their home localities. This is illustrated by the impressions of the bar scene in Tijuana compared to that in San Diego reported in a San Diego County telephone survey of youths aged 18 to 25 in which the respondents were asked to contrast the availability of various bar features in the two locations. As shown in [Figure 1](#), San Diego bars were perceived as the best places for food, entertainment, and safety, whereas the Tijuana bars, as might be expected, were seen as having the advantage of low prices and for avoiding carding (age checks). In addition, however, Tijuana was perceived as the better place to blow off steam, get drunk, and get drugs (Lange et al., 2002). This illustrates the perceived ability to get away from normative restraints. The border provides a passage into a new environment where home community norms do not apply to drinkers, where short-term deviant behavior will go uncriticized, and where it can be rationalized as low risk because, insofar as drinking is concerned, it is not relevant to normal lifestyle.

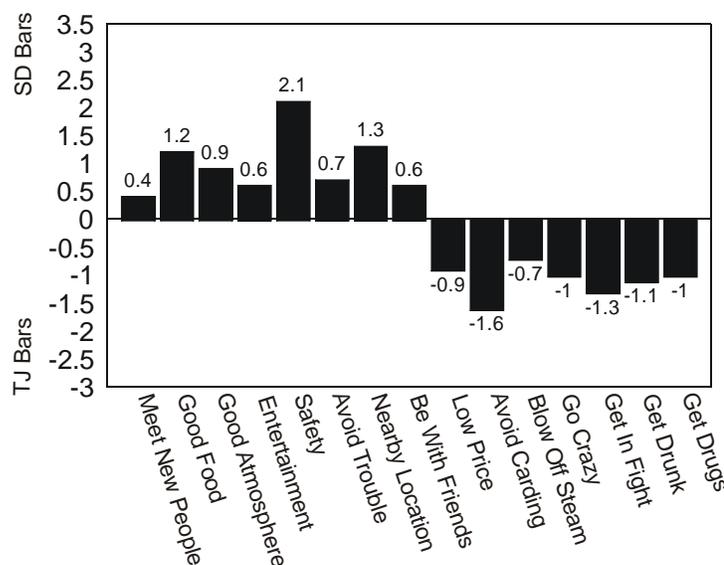


FIGURE 1 San Diego telephone survey of youths younger than 25—relative perception of bar features in San Diego (SD) versus Tijuana (TJ).

CLOSING ORDINANCE

We have conducted surveys at the border crossings into Tijuana (from San Diego) and Juárez (from El Paso), which we have described in detail elsewhere (Lange et al., 1999), to study this time-out phenomena and to test programs that might reduce drinking or the consequences of drinking (e.g., impaired driving) at the cross-border bars that cater to young Americans and exhibit some of the features of unlicensed events in the United States. In this process, we have identified enforcement programs and policies that reduce cross-border binge drinking such as sobriety checkpoints close to the border (Voas et al., 2002*b*), turning back minors aged 17 and younger at the border crossing who are not accompanied by parents (Voas et al., 2002*c*), and requiring special passes for military enlisted personnel crossing the border (Voas et al. 2002*a*). Although all these measures north of the border have added to the provision of a safer environment at the border, perhaps the single most effective and comprehensive action was taken by the Mexican government: the implementation of an early closing for the all-night bars in Juárez. This paper reports on the impact of the closing policy on youthful Americans crossing into Mexico to drink and considers their relevance to controlling unlicensed drinking events in the United States.

On January 1, 1999, the governor of Chihuahua ordered the bars in Juárez to close at 2 a.m. rather than remain open all night. This policy change occurred 18 months after we began surveying U.S. residents aged 18 to 30 returning to San Diego after a night of drinking in Tijuana. Nine months later, we began a similar survey of youthful Americans returning from Juárez to El Paso on weekends between midnight and 6 a.m. As a result of our continuous presence at the border, we were able to determine whether the change in policy affected the number of U.S. residents crossing into Mexico and their blood alcohol concentrations (BACs) when returning to the United States. Two studies have been conducted. The first covered the 1-year period following the implementation of the ordinance in Juárez (Voas et al., 2002*b*), and the second (Voas et al., 2006) covered a 7-year period beginning on January 1, 1999, when the

closing ordinance was implemented. The second study provided an opportunity to evaluate the long-term effects of the early bar-closing policy. Because the early-closing ordinance applied only to Juárez and not to other border locations, we used Tijuana as a comparison site in our first study to contrast the influence on individuals who returned early in the evening and therefore should be relatively unaffected by the ordinance with the late returnees on whom the early closing would be expected to have a major effect.

METHODS

In Juárez, Mexico, at the south end of the international bridge, a concentration of bars featuring music, low-cost alcohol, and an environment that encourages heavy drinking caters to young Americans. Our survey site is at the north end of the bridge just beyond where the U.S. emigration officer checks the IDs of returning residents. We conducted surveys continually from May 1998 to August 2005 between midnight and 6 a.m. on Saturdays and Sundays, on one weekend per calendar quarter. Data collection weekends were chosen at random within the quarter sampled. At the San Diego–Tijuana border, the bar strip that caters to young Americans is about a quarter mile from the border. Individuals returning from Tijuana file into a large enclosed waiting area that can hold up to a hundred or more crossers. We contact returnees immediately after they pass through the immigration and customs inspection; however, at the San Diego–Tijuana border surveys were conducted more frequently (one randomly chosen weekend a month from June 1997 to December 2000).

On weekend evenings between 1,000 and 2,000 young adults return from Juárez to El Paso between midnight and 6 a.m. In San Diego, the number returning approaches 6,000 to 8,000 on some Friday or Saturday nights. Our interview teams can process about 100 cases a night, so we must randomly sample from the total population of returnees. As each interviewer finishes with a participant and is ready to do another interview, he or she signals the supervisor, who approaches the very next individual crossing a specified line at the border facility. This ensures a random sample of the returnees. During our surveys a researcher records hourly counts of the total number of individuals (both those randomly sampled and those not sampled) crossing through the border facility between midnight and 6 a.m. These total population hourly counts can then be used to weight the random survey data.

The interview data are weighted based on the population counts of crossers per hour on each survey night divided by the number of participants sampled during that hour. Because our participants are randomly selected from the flow of crossers, weighted sample proportions are unbiased estimates of the population. The sampling system has produced consistent results across time within each location.

The El Paso sample is predominantly young and Hispanic, but also includes a substantial number of college students from New Mexico State University in Las Cruces, New Mexico (our data show no differences in the basic demographic characteristics of the population before and after the policy change). The comparison site (the San Diego sample) differs from the El Paso sample primarily in the percentage of crossers who are Hispanic (35% in San Diego compared to 79% in El Paso). A team of three interviewers and a supervisor conducts the surveys at each site. Spanish-speaking surveyors are available to respondents who prefer that language. Each interview takes approximately 5 min, after which the participant is asked to provide a breath

sample by blowing into a handheld SD400 fuel cell test unit. The border survey procedure is described in greater detail in Lange et al. (1999).

RESULTS

Study 1 (First 2 Years After Policy Change)

Our first study of the 2 a.m. closing law (Voas et al., 2002b) contrasted individuals returning from Mexico before versus after 3 a.m. who reported patronizing a bar or restaurant while in Mexico. The midnight to 3 a.m. early return period was selected to allow enough time for the late returnees (those who remained in the bars until the 2 a.m. closing) to come back across the border. The number of returnees in the early (midnight to 3 a.m.) versus late (3 a.m. to 6 a.m.) periods at the El Paso program site was compared with the number returning during the early and late periods at the San Diego comparison site by BAC level.

Figure 2 shows the percentage of change in the year following the implementation of the closing hour ordinance compared to the 9 months preceding the change in El Paso and 12 months preceding the change in San Diego. As can be seen, in Juárez during the period affected by the ordinance, there was an 85% decrease ($p < .01$) in the number of returnees with positive BACs. In the comparable period in San Diego, which was not affected by the ordinance, there was a nonsignificant 19% increase in the number of returnees with positive BACs. Figures 3 and 4 provide more of the same information broken down by BAC levels. There was an 82% decrease ($p < .01$) in the percentage of returnees with positive BACs lower than the legal limit and a 92% decrease ($p < .05$) for those with BACs higher than the limit in the affected period in El Paso, in contrast to nonsignificant rises in the same periods in the comparison crossing at San Diego.

An important issue was whether these large reductions in drinkers returning after 3 a.m. would be replaced by similar increases in the number of drinkers returning in the earlier period between midnight and 3 a.m. as the late returnees adjusted their drinking hours. As can be seen, in El Paso, there was a modest (23%) nonsignificant rise in the number of returnees with positive BACs

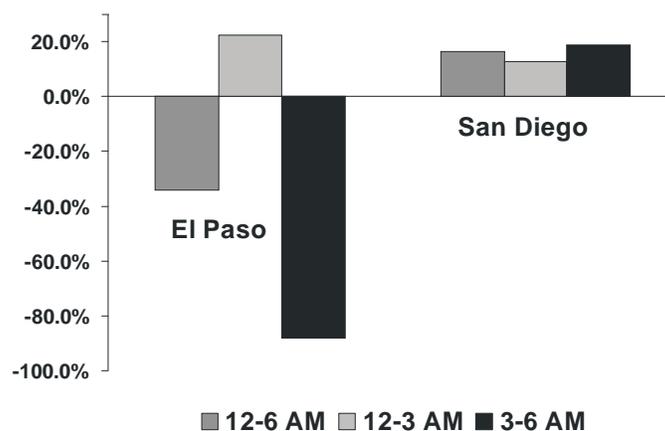


FIGURE 2 Percentage of change, following the 2 a.m. closing law, in the number of young Americans with positive BACs returning to the United States after a night of drinking in Mexican bars.

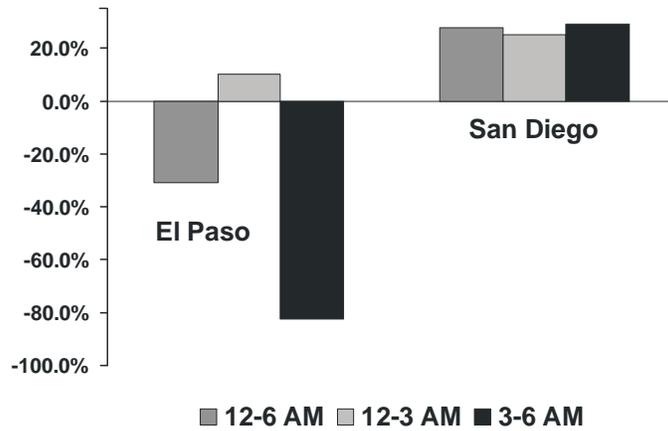


FIGURE 3 Percentage of change, following the 2 a.m. closing law, in the number of young Americans with BACs in the .020% to .079% range returning to the United States after a night of drinking in Mexican bars.

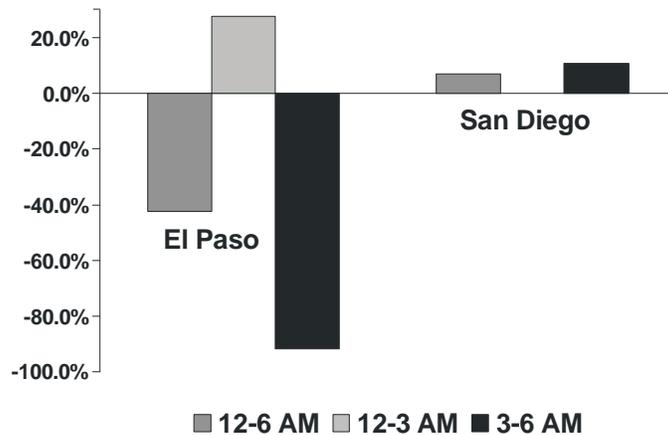


FIGURE 4 Percentage of change, following the 2 a.m. closing law, in the number of young Americans with BACs of .08% or higher returning to the United States after a night of drinking in Mexican bars.

from midnight to 3 a.m. That increase, however, was much smaller than the late-night decrease so that over the complete survey period (midnight to 6 a.m.), the number of drinking returnees decreased by a third. A more detailed presentation of this study is presented in Voas et al. (2002b).

Study 2 (7 Years After Policy Change)

With funding assistance from the Center for Substance Abuse Prevention, we continued to conduct, albeit on an intermittent basis, surveys at the El Paso–Juárez border for another 7 years following the end of Study 1 in December of 2000 (Voas et al., 2006). Overall, this provided data covering the period from May 1998 to August 2005, with samples of youths and young

adults returning to El Paso between midnight and 6 a.m. on Saturdays and Sundays, on one randomly chosen weekend per calendar quarter.

This continuation used the same procedure as those implemented in Study 1. We counted all individuals returning from Mexico between midnight and 6 a.m. and used a random contacting procedure to permit the projection of our interview and breath test data to the population of returnees. To ensure that the Juárez bars were conforming to the 2 a.m. closing ordinance, we sent observers in to the bar area to record whether they closed at 2 a.m.

Data Limitations

In both Study 1 and Study 2, a BAC measure was missing on about one in four of the respondents. BAC data for participants who refused to give a breath test were imputed using the “hot deck” procedure described in Lange et al. (1999). Between 2000 and 2005, surveys could not be conducted in some quarters because of funding lapses and temporary changes in U.S. border control agency (Immigration and Naturalization Service, Customs, Border Patrol) policies. In addition, surveys in some quarters would not have represented the long-term trends of border crossers (September 11, 2001, for example). Quarters with missing surveys are indicated on the figures by dotted lines. Not all late-night border crossers visited bars in Mexico; some visited families or friends (22.3%). We included in Study 2 only the crossers who reported patronizing a bar (45.5%) or a restaurant (20.1%) in Mexico.

Results

The objective of Study 2 was to answer three specific research questions. (a) Is the early bar-closing policy still being enforced? (b) Has the number of youths returning from Juárez remained at the reduced levels measured in 1999, the first year of the policy change? And (c) has there been any change in the characteristics of the crossers (age, gender, school or work status)?

Figure 5 shows the estimated number of young adults returning from Juárez bars and restaurants, by quarter, from April 1998 to September 2005. The estimates are based on the mean counts of returnees on Friday and Saturday nights of each quarter in two periods: midnight to 3 a.m. and 3 to 6 a.m. The graph clearly shows the dramatic fall in late-night returnees following implementation of the new closing law. Before the January 1, 1999, change in policy, the number of returnees before and after the 3 a.m. hour was approximately equal (1,000). After the policy change, the number of returnees after 3 a.m. fell to almost zero; there was little change in the number returning earlier.

The bar survey at Juárez (not shown) demonstrated that the ordinance was indeed enforced. The premises in the strip just beyond the pedestrian bridge in Juárez continued to close at 2 a.m. through August of 2005, with the exception of the weekends in December before Christmas when proprietors are given a dispensation to stay open until 3 a.m. There was no evidence of a return to the pre-ordinance, open all-night status.

Figure 5 shows that the effect of the 2 a.m. closing policy on the number of cross-border drinkers persisted for approximately 2 years. Further, the number returning after 3 a.m. remained small over the 6 years following the closing law. Conversely, the number of those returning before 3 a.m. increased substantially, particularly in the third year following the change in closing hours. Thus, although the number of young Americans returning after 3 a.m. has

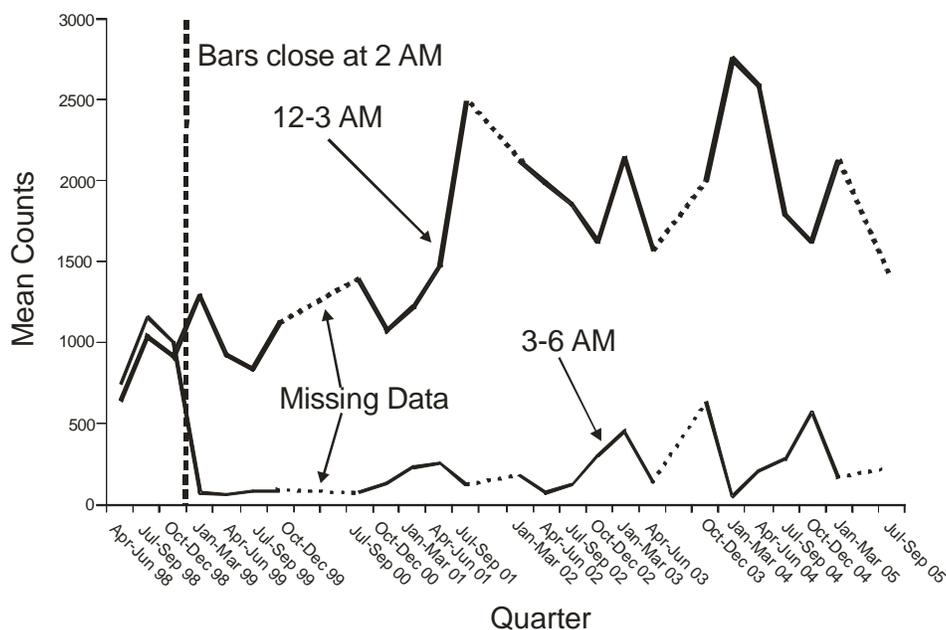


FIGURE 5 Number of U.S. residents returning from a night of drinking in bars and restaurants in Juárez, Mexico, by time of night. The three curves represent three age groups (18–20, 21–25, and 28–35). Dotted segments in each curve denote quarters for which survey data are missing (these segments are simple connectors between periods of known data). The vertical dotted line denotes the date of the policy change.

remained well below the prepolicy period, the number returning before 3 a.m. has increased to the point that it exceeds the pre-2 a.m. policy level.

Figure 6 shows the trend in the number of bar and restaurant patrons returning to El Paso over the period following the implementation of the 2 a.m. closing hour by age group. As can be seen, there is little change in the number of returnees in the 21 to 25 and 26 to 35 age groups, but there is a large rise in the number of underage drinkers returning from Juárez. By 2004, the number of underage returnees had doubled what it had been for that age group before the early-closing hour. Despite the increase in the number of visitors over recent years among the 18 to 20 age group and the 21 to 25 age group, the percentage of returnees with high BACs ($\geq .08$) did not change in the 7 years since the policy change. Figure 7 illustrates this finding: the increase of the number of visitors is shown by the vertical bars, and the relative flat curves indicate the BAC levels. A more detailed report on Study 2 appears in Voas et al. (2006).

DISCUSSION OF LAW'S INFLUENCE

For 6 years, with a minor exception for the December weekends before Christmas, the January 1, 1999, early-closing ordinance in Juárez has been effective in closing the all-night bars after 2 a.m. Clearly, that closing-policy has had a major influence on youthful Americans crossing the border to drink in Juárez bars and restaurants. For the first year after the law change, the number of crossers drinking late at night was reduced by 80% to 90%, and the total number of crossers was reduced by 40% to 50%. The overall number of cross-border drinkers remained lower for

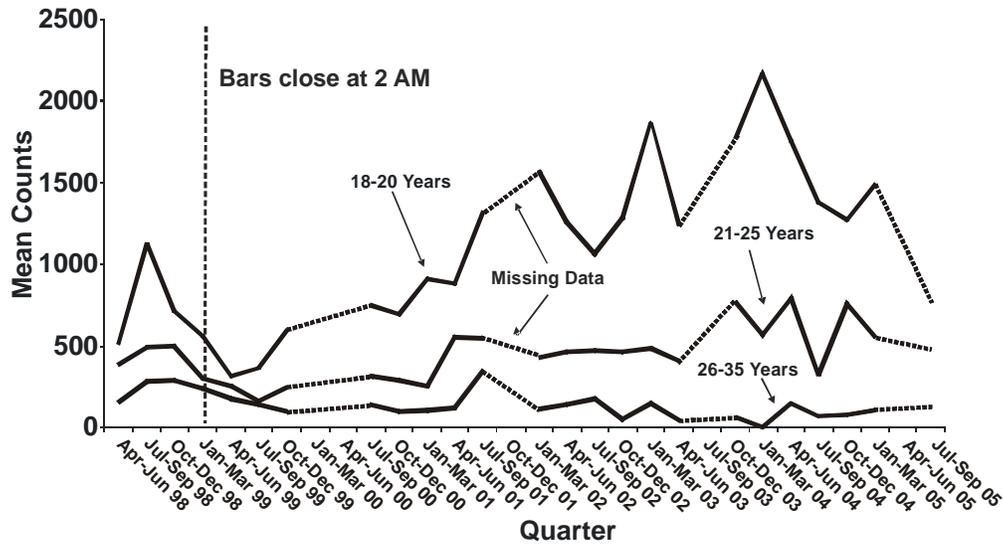


FIGURE 6 Number of youthful U.S. patrons of Mexican bars and restaurants returning to El Paso from 1998 to 2005.

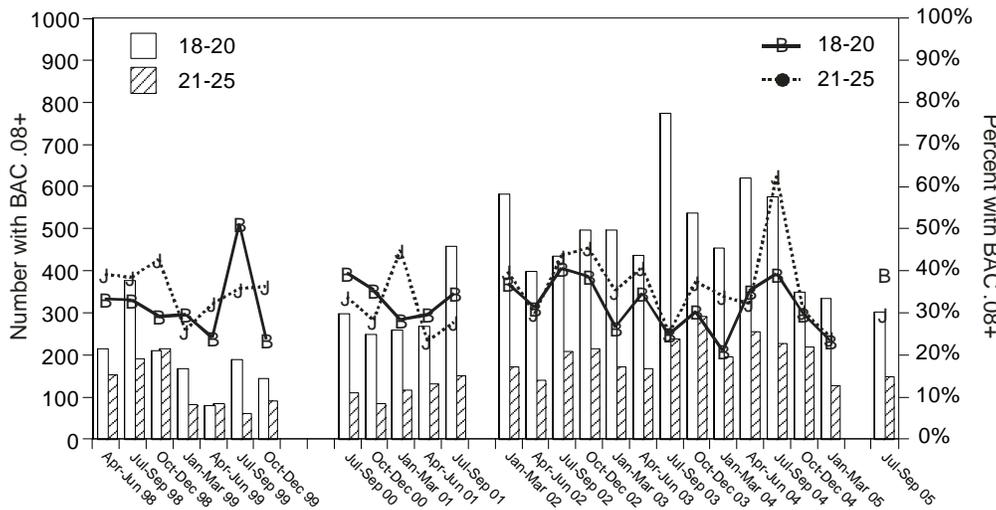


FIGURE 7 Number and average BAC of U.S. residents returning to El Paso after a night of drinking in Mexican bars and restaurants.

almost 2 years before it rose sharply in the third and fourth years following the law to return to the prelaw level.

The ordinance appears to be primarily displacing the drinking to earlier hours of the night. The data also suggest that such a displacement affected different segments of the visiting population. Our analysis shows that such policy erosion began shortly after its enactment in 1999, although it accelerated around 2002, particularly among college students. Evidence also

shows that the 2 a.m. bar-closing policy was enforced effectively for most of the 7 years but that enforcement relaxed around the December holidays. The observed displacement of visitors to earlier hours constitutes a potential limitation in the effectiveness of attempts to control alcohol availability by controlling hours or locations of sales.

The law's influence was greatest on underage drinkers who could not drink legally in the United States. Initially, it was protective for that group, but after 5 years the effect dissipated, and the number of underage drinkers crossing the border increased. These results raise at least two questions: (a) why the underage drinkers did not adjust their drinking hours when the new ordinance went into effect? and (b) why, having stopped crossing into Mexico, did they later return in greater numbers than before? This suggests that, for 2 years, a substantial portion of the underage drinkers who had been returning late from Juárez transferred their activities to the U.S. side of the border. It is not clear whether this resulted in a reduction in their drinking or whether their consumption was just displaced from Juárez to El Paso.

Unfortunately, we lack the data to answer those questions. Following the trail of the youths initially discouraged from crossing to drink and determining the influence on their alcohol consumption and alcohol-related risk taking would have required an integrated citywide data system on underage youth for which funding was not available. It appears clear, however, that the early-closing law created an opportunity for the city of El Paso to intervene in the heavy and risky drinking of the youthful crossers. It seems probable that considerable underage drinking was displaced onto the El Paso side of the border for 18 to 24 months. Anecdotal reports from the police indicate that, during that time, underage enforcement effort was shifted away from the border. It is tempting to speculate that the resulting increase in enforcement activity in the city and its outskirts moved the underage drinkers back across the border.

Speculation aside, it is clear that changes in regulations can be powerful because once enacted, they are likely to be maintained for long spans of time with relatively little effort from health and safety advocates. On the other hand, enforcing regulations requires considerable effort as illegal activity can be suppressed in one area only to be displaced to another. Border communities with high-risk drinking establishments just across the border face a particular problem because they have a nearby haven for problem drinking (Lange et al., 2002). To take advantage of major changes in alcohol sales regulations, communities must be organized to identify the displacement of drinking activity and work effectively to block the transfer of drinking problems from one locality to another.

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**Alcohol Sales and Service to Underage
Youth and Intoxicated Patrons**
*Effects of Responsible Beverage Service Training
and Enforcement Interventions*

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Drinking by underage youth and those already substantially impaired or intoxicated continue as major contributors to alcohol-related car crashes. To prevent alcohol-related problems, almost all states have made it illegal for licensed alcohol establishments to sell alcohol to underage youth or to customers who show obvious signs of intoxication. However, despite existing laws, many alcohol establishments, both off-premise (i.e., liquor and grocery stores) and on-premise (i.e., bars and restaurants), have serving practices that foster high-risk drinking behavior.

Extant literature indicates that servers at alcohol establishments rarely intervene to prevent intoxication or refuse service to intoxicated patrons (Donnelly and Briscoe, 2003). This lack of intervention is reflected in studies noting that pseudo-intoxicated patrons are able to purchase alcohol in 62% to 90% of purchase attempts (Toomey et al., 2004; Toomey et al., 1999). Additionally, evidence suggests that approximately a third of patrons leaving bars have blood alcohol concentrations (BACs) above the legal limit for driving (Stockwell et al., 1992; Werch et al., 1988), and between one-third and three-quarters of intoxicated drivers consumed their last alcoholic beverage at a bar (Foss, Beirness, and Sprattler, 1994; O'Donnell, 1985). Sales and service of alcohol to youth and those already impaired or intoxicated (also referred to as over service) contributes to many health problems, both those related to driving and others. For example, alcohol is involved in up to 39% of fatal traffic crashes, 76% of fatal traffic crashes between midnight and 3 a.m., 76% of rapes, 66% of violent incidents between intimate partners, 30% to 70% of drownings, 50% of homicides, 50% of assaults, and 38% of suicides (Bennet and Collins, 2000; Brecklin and Ullman, 2001; Driscoll, Harrison, and Steenkamp, 2004; Greenfeld and Henneberg, 2001; Martin, 2001; NHTSA, 2005b, 2005c; Smith, Branas, and Miller, 1999). Preventing further service of alcohol to those already substantially impaired by alcohol is a clear avenue to reduce traffic crashes and other health and social problems resulting from heavy episodic drinking.

Similarly, despite passage of the age 21 minimum legal drinking age (MLDA) legislation, underage youth can, and do, purchase and use alcohol. Seventy-seven percent of adolescents have consumed alcohol by the end of high school; and 44% have done so by the end of eighth grade (Johnston, O'Malley, Bachman, and Schulenberg, 2005). Further, purchase attempts indicate that between 45% to 50% of outlets sell to underage buyers (Forster et al., 1994; Perry et al., 2002; Toomey et al., 2001; Wolfson et al., 1996;). Alcohol use among adolescents contributes to traffic crashes, increased risk for disease, risky sexual behavior, violence, sexual assault, homicides, suicides, crime, and unintentional injury (Borowsky, Ireland, and Resnick, 2001; Dunn, Bartee, and Perko, 2003; Greenfeld, 1998; Gymiah-Brempong, 2001; NHTSA, 2004; National Institute on Alcohol Abuse and Alcoholism, 2000; Smith et al., 1999; Sorenson

and Berk, 2001; Wechsler, Mohler-Kuo, Dowdall, and Koss, 2004). In addition, recent research has shown that exposure to alcohol in adolescence can have detrimental effects on brain development, intellectual capabilities, and increases the likelihood for later addiction (Brown, Tapert, Granholm, and Delis, 2000; Monti et al., 2005). Further, one estimate of the societal cost of underage alcohol use in the United States is \$53 billion annually, attributed to loss of young lives, lost productivity, and health care costs (Pacific Institute for Research and Evaluation, 1999).

These findings point to a clear need for interventions to induce alcohol service staff to avoid selling alcohol to underage youth and those intoxicated, reduce the likelihood of drinkers becoming intoxicated, and prevent those who are noticeably impaired from driving. Alcohol sales and service practices often present the last clear chance of preventing alcohol-related traffic crashes and a variety of other problems.

RESPONSIBLE BEVERAGE SERVICE LAWS AND PROGRAMS

Responsible beverage service (RBS) programs are one strategy used to prevent illegal sales of alcohol to underage youth and intoxicated patrons. Traditional RBS programs educate servers and clerks at alcohol establishments about strategies to avoid illegally selling alcohol to underage youth or intoxicated patrons (Alcohol Epidemiology Program, 2006). Strategies may include offering patrons food with drinks, delaying service to rapid drinkers, refusing service to intoxicated or underage patrons, and discouraging intoxicated patrons from driving (Shults et al., 2001). Additionally, programs can reinforce the importance of checking age identification of customers who appear under age 30, and teach service staff how to identify false age identification documents and what to do once one is detected, recognize situations in which adults are buying alcohol for underage youth, refuse sales to individuals who may supply alcohol to underage youth, and identify intoxicated customers (Toomey et al., 2001).

Alternatively, training efforts can also target owners and managers, teaching them how to set establishment policies and to monitor staff and enforce policies to reduce risk of over service. Because employment duration for clerks and servers at alcohol establishments is relatively short, with high turnover rates, training owners and managers presents a logical solution for sustaining RBS practices. In addition, owners and managers who have been trained themselves are more likely to provide support for RBS practices in their establishments and will increase the likelihood that changes in server or seller behavior will be sustained (Shults et al., 2001).

Many RBS programs are implemented on a purely voluntary basis. But state and local governments can also support responsible service practices through statutory provisions (i.e., laws) for either mandatory or incentive-based voluntary RBS training programs. Voluntary programs provide incentives for retailers to participate in RBS (e.g., liability defense, mitigation of fines, discount insurance, and protection of license), but do not impose penalties for those who do not. A program is designated as mandatory if state law requires at least some alcohol retail employees to attend RBS training of some kind (NHTSA, 2005a). These statutes are enacted by state legislatures and the associated regulations promulgated through an administrative process, usually conducted by the relevant state Alcohol Beverage Control (ABC) agency. As of July 1, 2005, 17 states and the District of Columbia have mandatory RBS training, 15 have statutory provisions for voluntary RBS training, and 18 do not have legislation requiring training (Alcohol Policy Information System, 2005; see Table 1).

In a qualitative review of RBS programs in 23 states, Mosher, Toomey, Good, Harwood, and Wagenaar (2002) identified five components of RBS legislation: program requirements, administrative

requirements, enforcement, penalties, and benefits. Each component contributes to the strength of the legislation and, subsequently, its efficacy in reducing illegal access to alcohol by underage youth and intoxicated patrons. The authors suggest that, at a minimum, programs should review all basic information relevant to servers; be based on scientific behavior change and communication techniques; target both managers and servers; include development of management policy for the alcohol outlet; and have a minimum length of 4 h. In addition, state legislation should specify administrative requirements that provide the means to evaluate and certify training programs, track which licensees and servers have completed the training, and establish a framework for imposing penalties on violators through suspension or revocation of a certification or license to sell or serve alcohol. Inherent in these specifications is the need to identify procedures for recertification of trainers and trainees at regular time intervals. Specifications for statute enforcement are also essential as the benefits of deterrence improve with perceived certainty of penalty imposition and the perception that it will be relatively swift. Mosher et al. (2002) note that while voluntary programs do not require an enforcement mechanism, mandatory programs should provide active surveillance of training programs, licensees, and, to a lesser extent, servers. Further, the authors suggest graduated administrative penalties (i.e., penalties that increase in severity for repeat violations that are based in civil, not criminal law) and appropriate benefits for voluntary participation in RBS training in incentive states.

In short, RBS programs may target servers and clerks, owners and managers, or both. Additionally, RBS training can be encouraged, through incentive-based programs, or mandated by state and local governments. At present, over half of the states in the United States have statutory provisions for mandatory or incentive-based voluntary programs (Table 1). However, there is great variation in program requirements among the states, likely resulting in a high variation in effectiveness.

TABLE 1 Status of Server Training by State (as of July 1, 2005)

Mandatory Server Training (n = 18)		
Alaska	Michigan	Rhode Island
Delaware	Nevada	Tennessee
District of Columbia	New Hampshire	Utah
Indiana	New Jersey	Vermont
Louisiana	New Mexico	Washington
Maryland	Oregon	Wisconsin
Voluntary Server Training (n = 15)		
Alabama	Florida	North Carolina
Arizona	Illinois	Pennsylvania
Arkansas	Maine	South Dakota
California	Montana	Texas
Colorado	New York	Wyoming
No Law (n = 18)		
Connecticut	Kentucky	North Dakota
Georgia	Massachusetts	Ohio
Hawaii	Minnesota	Oregon
Idaho	Mississippi	South Carolina
Iowa	Missouri	Virginia
Kansas	Nebraska	West Virginia

EVIDENCE FOR EFFECTS OF RBS PROGRAMS

Evaluations of responsible service programs first appeared in the mid-1980s. These early programs focused primarily on training servers to recognize and refuse service to intoxicated patrons. However, since this approach did not fundamentally prevent intoxication among adult patrons nor address sales to underage youth, these programs quickly evolved to address preventing sales to minors and preventing intoxication among patrons. Additionally, most early RBS training programs focused on servers and clerks alone. They had some effects on knowledge levels of servers and clerks, but most had little or no effect on actual serving practices, drinking behavior, or alcohol-related problems. The target audience for RBS programs then evolved in the late 1990s, with establishment owners and managers being trained in addition to servers and clerks. This evolution reflects the more comprehensive term “responsible beverage service” rather than the earlier use of the term “serving training.” Owners and managers should be creating and enforcing policies in their establishments that create an environment that fosters responsible serving practices.

The extant literature regarding effects of these programs typically assesses a subset of three main outcome domains: server knowledge, attitudes, and behavior; alcohol consumption or alcohol sales; and motor vehicle crashes. Effects of RBS efforts across these three domains are presented next.

A comprehensive search of the published scientific literature on effects of responsible beverage service programs reveals 34 papers. Twenty-five of these publications report specifically on the effects of RBS interventions, with some papers reporting effects across multiple outcome domains. Nine publications report findings from multicomponent community interventions, of which RBS training was only a part. Studies differ substantially in intervention and methodological quality—some evaluating voluntary RBS programs and others mandatory statewide efforts, some with time- and content-intensive curricula and others briefer, some carefully controlled with comparison groups and others with more rudimentary designs and analyses.

Server Knowledge, Attitudes, and Behavior

Most ($n = 14$) of the extant literature reports effects of RBS programs on server knowledge, attitudes and behavior (Table 2). Several ($n = 10$) studies show improvements in server knowledge and beliefs following RBS training (Coutts, Graham, Braun, and Wells, 2000; Glicksman et al., 1993; Glicksman and Single, 1988; Howard-Pitney, Johnson, Altman, Hopkins, and Hammond, 1991; Lang, Stockwell, Rydon, and Beel, 1998; McKnight, 1991; McKnight and Poley-Weinstein, 1987; Molof and Kimball, 1994; Riccelli, 1986; Simons-Morton and Cummings, 1997). However, improved knowledge and beliefs has not always led to observable changes in behavior. Seven studies reported increases in responsible beverage practices, such as offering food with beverages, refusals to serve alcohol, and asking about driving (Buka and Birdthistle, 1999; Glicksman et al., 1993; Glicksman and Single, 1988; McKnight, 1991; McKnight and Poley-Weinstein, 1987; NHTSA, 1986; Russ and Geller, 1987). Conversely, three studies reported no change in server behavior following RBS training (Howard-Pitney et al., 1991; Lang, Stockwell, Rydon, and Beel, 1996; Lang et al., 1998).

TABLE 2 Literature Assessing Effects of RBS Programs on Server Knowledge, Attitudes, and Behavior

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
NHTSA	1986	4-h program for National Basketball Association arenas; curriculum addressed: the problem of drinking and driving, liability law, alcohol's effects, recognizing impairment, policies and practices, and dealing with alcohol- and drug-related incidents	Pretest/posttest	Yes	Unknown	Following training, an increase in food and nonalcoholic beverage sales was found.
Riccelli	1986	5-h program for owners and bartenders; curriculum addressed speed-alcohol patrol activities, enforcement procedures, liability issues, alcohol physiology, alcoholism, and strategies for RBS practices. A comprehensive media campaign was also initiated.	Cross-sectional	No	Descriptive	Following server-management training in Amherst, Massachusetts, 72% of trainees felt they had a better knowledge of strategies to use in preventing the intoxication of patrons.
McKnight	1987	3-h program for servers and 6-h program for managers; server curriculum addressed: liability, responsibility to prevent intoxicated patrons from driving, psychological effects of alcohol, checking ID, serving food with alcoholic beverages, observing signs of impairment, handling intoxicated customers, delaying service, providing alternative transportation and refusing service. In addition to this curricula, curricula for managers covered intervention skills and policy development.	Pretest/posttest	Yes	<i>t</i> -tests	Following training, increased server knowledge, policy changes, and increases in refusals to serve alcohol were reported.
Russ and Geller	1987	6-h program for servers; taught behavioral and psychological cues associated with alcohol effects and tactics for controlling flow of alcohol; utilized videotaped vignettes, leader facilitated discussions, and server role-play segments	Pretest/posttest	No	ANOVA	Pseudopatrons (n = 25) served by trained personnel reached substantially lower BACs than those served by untrained servers; trained servers initiated more interventions toward pseudopatrons than untrained servers.

(continued)

TABLE 2 (continued) Literature Assessing Effects of RBS Programs on Server Knowledge, Attitudes, and Behavior

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Howard-Pitney et al.	1991	1-day program for servers and managers; taught physical and behavioral effects of alcohol and strategies for providing RBS; utilized lectures, role play, and feedback techniques	Pretest/posttest	Randomized	<i>t</i> -tests	Following training, servers demonstrated improved knowledge and attitudes. However, no change in server behavior; some indication that management policies were more responsible in intervention sites.
McKnight	1991	6-h program for servers and managers; taught need for RBS, methods for preventing intoxication, methods for intervening with intoxicated patrons, policy formulation, and manager program administration	Pretest/posttest	Yes	ANOVA	Following training of over 1,000 servers and managers in 100 establishments in eight states, servers demonstrated improved knowledge, attitudes, and self-reported behavior; increased server interventions were found but very few cut off service to alcohol.
Glicksman et al.	1993	4.5-h program for servers and managers; managers taught about legal obligations and policy development; servers instructed in RBS	Pretest/posttest	Yes	ANOVA	Following server training in eight establishments in Ontario, servers demonstrated increased knowledge and improved serving behaviors toward pseudo-intoxicated and pseudo-underage patrons.
Molof and Kimball	1994	Mandatory 1-day training for servers and managers; curriculum covers alcohol effects on the body, interaction effects with other drugs, problem drinking and alcoholism, State of Oregon service laws; Oregon drinking and driving laws and liability issues; effective intervention techniques, and alcohol marketing practices for RBS	Pretest/posttest	No	<i>t</i> -tests	Following training, servers and managers demonstrated improved knowledge.
Lang et al.	1996	Training for servers and managers; curriculum covered liquor licensing laws, signs of approaching and actual drunkenness, strategies for dealing with drunk customers, general facts about alcohol, and development of responsible establishment policies	Pretest/posttest (two follow-up assessments)	Yes	Regression	Staff rarely checked the ID of pseudopatrons before or after server training; door staff were more likely to check ID of females and bar staff were more likely to check ID of males.
Simmons-Morton and Cummings	1997	Training for servers at three Texas Alcohol Beverage Commission approved classes	Pretest/posttest	No	Paired <i>t</i> -test	Server training provided significant improvements in participants' perceptions of their role in preventing drinking and driving.

(continued)

TABLE 2 (continued) Literature Assessing Effects of RBS Programs on Server Knowledge, Attitudes, and Behavior

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Lang et al.	1998	1- to 2-h program for servers and manager; curriculum addressed laws regarding service to underage and intoxicated patrons, recognizing signs of intoxication, strategies for dealing with drunken customers, alcohol and its effects, and establishment policy development	Pretest/posttest	Yes	Regression	Results indicated minor increases in knowledge, most of which were not retained at follow-up; also, no significant reduction in the number of drunk-driving offenses.
Buka and Birdthistle	1999	5-h program for servers; curriculum targeted: knowledge and skill to prevent intoxication, prevention of service to minors, identification of and cutting off service to intoxicated patrons, and legal liability	Prospective cohort	Yes	Mixed effect modeling	Following server training in Rhode Island, significantly higher levels of RBS behaviors were found among trained servers versus non-trained servers.
Coutts et al.	2000	3-h program for servers; curriculum addressed: communication skills, effects of alcohol, preparation for situations that make patrons angry, and handling problem situations	Pretest/posttest	No	Paired <i>t</i> -tests	Following training of 121 bar staff from eight bars, improved attitudes and knowledge were found; bar staff were receptive to the training.
Donnelly and Briscoe	2003	Mandatory RBS training for establishments seeking a new license or transfer of license in New South Wales; specifics of training not provided.	Cross-sectional	No	Descriptive	Among 1,090 people aged 18–39 years reporting at least one sign of intoxication at their last drinking occasion, 10% reported that the licensed premises staff took one of seven RBS initiatives, while 55% reported that they continued to be served alcohol. Among those showing three or more signs of intoxication, only 4% were refused more alcohol.

Alcohol Consumption or Sales Practices

Eight studies reported on the effects of RBS programs on alcohol consumption or sales practices (Table 3). Of these, six reported clear decreases in alcohol consumption or BACs among patrons (Glicksman et al., 1993; Lang et al., 1998; NHTSA, 1986; Russ and Geller, 1987; Saltz, 1987; Toomey et al., 2001), and two reported patrons having lower self-reported consumption but no change in patrons' estimated BAC levels (Hennessy and Saltz, 1989; Mosher, Delewski, Saltz, and Hennessy, 1989). Toomey et al. (2001) implemented a program that focused strongly on training owners and managers and assisted them in developing and enforcing policies in their establishment to prevent risky or illegal sales. They reported a decrease in sales to underage buyers of 11.5% and a decrease in sales to pseudo-intoxicated buyers of 46%, although the number of outlets in the trial was modest.

One study examined the correlation between self-reported training activities at alcohol outlets and observed purchase rates by underage youth (Wolfson et al., 1996). Self-reported training of staff involved in alcohol sales was associated with an observed 19% lower purchase success rate.

Traffic Crashes

Three studies examined effects of RBS training on traffic crashes and motor vehicle fatalities (Table 4). Molof and Kimball (1994) reported that following implementation of statewide mandatory server training in Oregon, there was no change in single-vehicle nighttime traffic fatalities. In contrast, Holder and Wagenaar (1994), also studying the Oregon experience with a statewide law requiring RBS training, report a significant decrease in traffic crashes of 23%. Riccelli (1986) studied effects of RBS training on crashes in Amherst, Massachusetts, and reports a 54% decrease.

Multicomponent Interventions That Include RBS

Recognizing the minimal effects of RBS interventions alone, researchers have imbedded these activities within larger, multicomponent community interventions designed to reduce risky drinking behaviors and subsequent sequelae. Nine publications report effects of multicomponent interventions that include RBS training (Table 5).

Following community interventions which included RBS training, community mobilization and policy initiatives, Hauritz, Homel, McIlwain, Burrows, and Townsley (1998) and Wallin, Gripenberg, and Anderson (2002, 2005) reported significant improvements in server behaviors. Additionally, Hauritz and colleagues found a sharp decline in observed signs of intoxication for males following the intervention. They did not find a significant change in drinking behavior by men or women. Holder et al. (2000) reported a 51% decrease in self-reported drunk-driving behavior, a 10% decline in nighttime injury crashes, and a 6% decline in crashes in which the driver had been drinking following an intervention that included RBS training, community mobilization, increased enforcement of drunk-driving policies, and various policy initiatives. Roeper, Voas, Padilla-Sanchez, and Esteban (2000) produced similar findings with 116 fewer injury crashes in intervention communities attributed to an intervention which included RBS training, media advocacy, increased enforcement of drunk driving and underage

TABLE 3 Literature Assessing Effects of RBS Programs on Alcohol Consumption or Sales Practices

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
NHTSA	1986	4-h program for National Basketball Association arenas; curriculum addressed: the problem of drinking and driving, liability law, alcohol's effects, recognizing impairment, policies and practices, and dealing with alcohol- and drug-related incidents	Pretest/posttest	Yes	Unknown	Following training, some changes in policies and consumption were reported.
Russ and Geller	1987	6-h program for servers; taught behavioral and psychological cues associated with alcohol effects and tactics for controlling flow of alcohol; utilized videotaped vignettes, leader facilitated discussions and server role-play segments	Pretest/posttest	No	ANOVA	Pseudopatrons (n = 25) served by trained personnel reached substantially lower BACs than those served by untrained servers; trained servers initiated more interventions toward pseudopatrons than untrained servers.
Saltz	1987	18-h program for management and servers; addressed revision of establishment policies and taught server roles, problems associated with alcohol use, how to identify and respond to potential problems	Pretest/posttest	Yes	Regression	Following training, reductions in the patrons' rate of consumption and the proportion of customers over standard drink size were found.
Hennessy and Saltz	1989	18-h program for management and servers; addressed revision of establishment policies and taught server roles, problems associated with alcohol use, how to identify and respond to potential problems	Pretest/posttest	Yes	Regression	Following server training, patrons had lower consumption but no change was seen in patrons' estimated BAC levels.

(continued)

TABLE 3 (continued) Literature Assessing Effects of RBS Programs on Alcohol Consumption or Sales Practices

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Mosher et al.	1989	Two 3-h training sessions for managers and servers; manager curricula addressed the role of the hospitality industry, environmental forces affecting business, legal liability, assessing business practices, levels of service, risk assessments of the business, policy development, and policy implementation; server curricula addressed the role of the hospitality industry, why people drink, legal liability, professionalism and service, signs of immaturity, alcohol physiology, assessing a guest's condition, age identification, drink size, promotion and advertising, stages of intoxication, and intervening with an intoxicated guest	Pretest/posttest	Yes	Regression	Following training, no significant change found in the number of customers leaving drinking establishments with BAC levels over 0.10 mg/ml.
Wolfson et al.	1996	NA	Cross-sectional	No	Regression	In 28 northern Minnesota communities, bars were less likely than liquor stores to sell to young buyers; among bars, having a manager on-site and training for servers were associated with lower purchase success rates.

(continued)

TABLE 3 (continued) Literature Assessing Effects of RBS Programs on Alcohol Consumption or Sales Practices

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Lang et al.	1998	1- to 2-h program for servers and manager; curriculum addressed laws regarding service to underage and intoxicated patrons, recognizing signs of intoxication, strategies for dealing with drunken customers, alcohol and its effects, and establishment policy development	Pretest/posttest	Yes	Regression	Results indicated minor increases in knowledge, most of which were not retained at follow-up; also, no significant reduction in the number of drunk-driving offenses.
Toomey et al.	2001	Five 1- to 2-h consultation sessions with establishment owners/managers; sessions included a risk assessment, alcohol policy recommendations, informing staff of the importance of the new policies, and how to actively monitor and enforce the new policies	Pretest/posttest	Yes	ANCOVA	Following implementation of Project ARM: Alcohol Risk Management in five diverse bars, underage sales decreased by 11.5%, and sales to pseudo-intoxicated patrons decreased by 46%. Results were in the hypothesized direction but not statistically significant.

TABLE 4 Literature Assessing Effects of RBS Programs on Traffic Crashes

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Riccelli	1986	5-h program for owners and bartenders; curriculum addressed speed–alcohol patrol activities, enforcement procedures, liability issues, alcohol physiology, alcoholism, and strategies for RBS practices. A comprehensive media campaign was also initiated.	Posttest only	No	Descriptive	Following server–management training in Amherst, Massachusetts, a 54% to 64% decrease in traffic crashes was found.
Holder and Wagenaar	1994	Mandatory 1-day training for servers and managers; curriculum covers alcohol’s effects on the body, interaction effects with other drugs, problem drinking and alcoholism, state or Oregon service laws; Oregon drinking and driving laws and liability issues; effective intervention techniques, and alcohol marketing practices for RBS.	Interrupted time series	Yes	ARIMA	Following policy implementation mandating server training, single-vehicle nighttime crashes declined 23% after 3 years.
Molof and Kimball	1994	Mandatory 1-day training for servers and managers; curriculum covers alcohol’s effects on the body, interaction effects with other drugs, problem drinking and alcoholism, state or Oregon service laws; Oregon drinking and driving laws and liability issues; effective intervention techniques, and alcohol marketing practices for RBS	Interrupted time series	No	ARIMA	Following training, no significant change in motor vehicle fatalities were found.

TABLE 5 Literature Assessing Effects of Multicomponent Interventions That Include RBS Training

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Grube	1997	1.5-h training for servers, 2.5-h training for managers; curriculum covered state underage sales laws, responsibility and role in preventing sales to minors, procedures for checking age ID and detecting false ID, and skills to refuse sales to minors; additionally, manager curriculum addressed legal liability; increased underage sales enforcement activities were undertaken by local police; media campaign to elicit community support for, and raise awareness of, enforcement efforts	Pretest/posttest	Yes	Regression	Establishments that sold to pseudo-underage patrons reduced from 53% to 19% in experimental communities, compared to 47% to 35% in controls.
Hauritz et al.	1998	Multicomponent intervention that included server training, policy initiatives, and community mobilization	Pretest/posttest	No	t-test	Following an intervention that included server training, server behaviors improved and male drunkenness declined sharply; no significant change in drinking rates for males and females.
Holder	2000	Multicomponent community intervention that included community mobilization, RBS training for servers and management of on-premise alcohol establishments, drunk-driving enforcement, reduction of access to minors, and local zoning to limit outlet numbers and density	Pretest/posttest; time series	Yes	Regression	Following a community trial in three communities, reductions in alcohol-involved traffic crashes and increased RBS practices of bars and restaurants were found.

(continued)

TABLE 5 (continued) Literature Assessing Effects of Multicomponent Interventions That Include RBS Training

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Holder et al.	2000	Multicomponent community intervention that included: community mobilization, RBS training for servers and management of on-premise alcohol establishments, drunk-driving enforcement, reduction of access to minors, and local zoning to limit outlet numbers and density	Time series	Yes	Relative ratio; regression	Following a community trial in three communities, self-reported drunk driving decreased 51%, nighttime injury crashes declined by 10%, and crashes in which the driver had been drinking declined by 6%.
Roeper et al.	2000	Multicomponent community intervention that included community mobilization, RBS training for servers and management of on-premise alcohol establishments, drunk-driving enforcement, reduction of access to minors, and local zoning to limit outlet numbers and density	Time series	Yes	<i>t</i> -test	Following a multicomponent intervention in Salina, California, there was a reduction in nighttime traffic injuries and admissions to hospitals due to traffic accidents. There were 116 fewer injury accidents, representing a savings of \$7,076,000 in 38 months.
Wagenaar et al.	2000a	Community mobilization program in which a part-time community organizer worked with local public officials, enforcement agencies, alcohol merchants, the media, schools, and other community groups to reduce youth access to alcohol. Server-management training was one strategy used by many of the intervention communities.	Pretest/posttest	Randomized	Regression	Following the intervention, on-premise alcohol establishments experienced a 17% increase in the proportion of checking age ID and a 24% reduction in sales to pseudo-underage buyers. Among off-premise outlets, there was 15% increase in the proportion of checking age ID and an 8% reduction in sales to pseudo-underage buyers.

(continued)

TABLE 5 (continued) Literature Assessing Effects of Multicomponent Interventions That Include RBS Training

Author(s)	Year	Intervention	Design	Comparison Group	Method	Findings
Wagenaar et al.	2000b	Community mobilization program in which a part-time community organizer worked with local public officials, enforcement agencies, alcohol merchants, the media, schools, and other community groups to reduce youth access to alcohol. Server-management training was one strategy used by many of the intervention communities.	Time series	Randomized	Regression	Following the intervention, a net decline in arrest and traffic crash indicators was also observed. However, only the decline in DUI arrests among 18 to 20 year olds was statistically significant.
Wallin et al.	2002	Community prevention program that included server training in RBS and policy initiatives	Pretest/posttest	Yes	Regression	Following the 3-year program in Stockholm, pseudo-intoxicated patrons were denied service at 47% of establishments, compared to 5% at baseline (but no difference between intervention and controls).
Wallin et al.	2005	Community prevention program that included server training in RBS and policy initiatives	Pretest/posttest	Yes	Regression	Pseudo-intoxicated patrons were denied service at 70% of establishments, compared with 47% in 1999 and 5% in 1996.

sales laws, and policy initiatives to limit the number of alcohol outlets and drinking in public places.

Two studies report declines in alcohol sales to pseudo-underage buyers following multicomponent interventions. In an evaluation of an intervention that included RBS training, increased enforcement of underage sales laws and media advocacy, Grube (1997) reported a reduction in sales to pseudo-underage buyers from 53% to 19% in treatment communities. Wagenaar et al. (2000a) reported similar reductions following an intervention that employed community mobilization strategies to reduce youth access to alcohol. They report a 24% reduction in sales to pseudo-underage buyers for on-premise (i.e., bars and restaurants) alcohol establishments and an 8% reduction in sales to pseudo-underage buyers for off-premise (i.e., liquor and grocery stores) alcohol establishments.

While the results of these multicomponent interventions are promising, the extent to which the RBS components have contributed to these outcomes remains ambiguous. It could be that RBS training is contributing to observed effects of these interventions. However, as the results from studies specifically examining RBS training suggest, this contribution may be modest at best. Perhaps more likely is that RBS training facilitates community acceptance of enforcement and other intervention activities, and those other activities are largely contributing to observed beneficial effects.

ENFORCEMENT OF SALES LAWS

Extant literature shows that compliance with laws improves when those subject to mandates believe that violations will be detected and punished (Ross, 1984, 1992). The deterrent effect is affected by their penalty severity, perceived probability of their imposition, and the swiftness with which they are imposed. Deterrence is therefore dependent on active, visible enforcement. Hence, to ensure responsible serving practices at alcohol establishments, enforcement of requirements for responsible serving practices is key.

Few studies have specifically examined effects of enforcement on alcohol sales to underage youth and intoxicated patrons. For sales to underage youth, results show that enforcement reduces sales, with reductions in successful purchase attempts by underage youth ranging from 30% to 50% (Lewis et al., 1996; Preusser, Williams, and Weinstein, 1994; Scribner and Cohen, 2001). McKnight and Streff (1994) similarly found a rise in refusals of service to pseudo-intoxicated patrons from 17.5% to 54.3% following increased enforcement of laws prohibiting sales to intoxicated patrons. A number of studies have included enforcement strategies as part of larger multicomponent community intervention trials designed to reduce youth access to alcohol, youth drinking, and alcohol-related problems (Grube, 1997; Holder et al., 1997, 2000; Perry et al., 2002; Wagenaar, Murray, Wolfson, Forster, and Finnegan, 1994; Wagenaar et al., 2000a, 2000b). Each of these community intervention trials found that alcohol sales to youthful buyers decreased in intervention communities compared to control or comparison communities. However, because these community interventions combined multiple strategies, the specific effects of enforcement can not be isolated.

One recently completed intervention trial specifically tested the separate effects of two interventions: server-management training and police enforcement checks (Wagenaar, Toomey, and Erickson, 2005a, 2005b) and evaluated their effects on sales and service to underage patrons.

The design of this trial also specifically assessed the durability or decay of observed effects, and will therefore be discussed in some detail here.

“COMPLYING WITH THE MINIMUM DRINKING AGE” TRIAL

Complying with the Minimum Drinking Age (CMDA) was a multiple time-series quasi-experimental community trial with a cohort design nested within the time-series quasi-experiment. This trial was designed to test the effects of two interventions designed to reduce alcohol sales to minors: (a) training for management of retail alcohol establishments and (b) enforcement checks of alcohol establishments (see Wagenaar et al., 2005a and 2005b for a detailed description of this trial and its outcomes). Intervention sites consisted of one large urban city and 10 surrounding suburban incorporated cities; comparison sites included one large urban city and eight surrounding suburban incorporated cities.

Intervention-community establishments were offered a free, one-on-one 2-h training program (plus a 1-h booster session) called Alcohol Risk Management-Express (ARM Express). ARM Express was designed for the self-identified decision maker at the establishment (either owner or manager) to encourage them to select and implement up to 19 model alcohol policies and practices, which are designed to create an operational and normative environment that supports responsible service of alcohol (see Toomey et al., 2001, for details on a five-session version of this program).

One hundred and nineteen of the eligible intervention establishments (38%) participated in the program between February 1999 and January 2000. These establishments were also offered a 1-h booster session (to review recommended alcohol policies and update resource materials), with 96 (31%) of the establishments participating in the booster training (81% of those that had participated in the initial training session).

A second, deterrence-based intervention involved enforcement checks (youth under age 21 attempting to purchase alcohol from licensed establishments) by local law enforcement. Each community determined the schedule and numbers of enforcement checks. The total number of enforcement checks conducted in the intervention communities was 959.

The core outcome—propensity for alcohol sales to minors—was directly tested with research staff who attempted to purchase alcohol without showing age ID using a standardized protocol in 602 on-premise and 340 off-premise alcohol establishments. Data were collected every other week in all communities for 4 years. Mixed-model regression and Box-Jenkins time-series analyses were used to assess short- and long-term establishment-specific and diffused community-level effects of the two interventions.

Effects of the training intervention were mixed, at best. The training and booster sessions had no significant effects on off-premise establishments—meaning the training had no apparent effects on the likelihood of illegal alcohol sales to youth, specifically on the particular establishments participating in the training. On-premise establishments showed an unexpected effect of training, with participating establishments showing an initial, nonsignificant reduction in the likelihood of sales, with a significant long-term increase in sales of approximately 7%. Analyses of community-level outcomes of the training intervention showed that in intervention suburbs, an increase in the number of establishments trained was followed 6 weeks later by a statistically significant reduction in propensity of establishments to sell alcohol to youth. This effect was not seen in the more urbanized intervention core city. Noteworthy is the fact that only

38% of establishments offered the training agreed to participate. Even if more effective training programs can be developed, the overall effects of voluntary training will be limited by low participation rates.

Analyses revealed a clear, specific-deterrent effect of the enforcement check component. Results show a 17% decrease in an off-premise establishment's (i.e., grocery and liquor stores) likelihood of selling alcohol to youth immediately following a law enforcement check. This effect decayed to an 11% decrease in the likelihood of selling at 2 weeks following an enforcement check and to a 3% decrease in the likelihood of selling at 2 months following an enforcement check. Enforcement effects eventually decay to zero among off-premise outlets, with no residual long-term permanent effect of a single check. In contrast, effects of enforcement in on-premise establishments (i.e., bars and restaurants) had significant initial and long-term effects. There was a 17% decrease in the likelihood of selling immediately following an enforcement check, with this decaying over time to a 14% decrease in the likelihood of selling at 2 weeks and a 10% decrease at 2 months. The long-term decrease in likelihood was 8.2%. Beyond the effects on service and sales behaviors in the specific outlets experiencing an enforcement check, a general deterrent effect of enforcement was also found in some study cities. An increase in the number of enforcement checks in a community led to an immediate reduction in sales to young-appearing buyers in that community.

Results of this trial have clear implications for the scheduling of enforcement check campaigns and training requirements. Given that the effects of enforcement checks dissipate completely in off-premise establishments and decreased to half of the initial effect within 3 months in on-premise establishments, conducting enforcement checks in all establishments once, even twice, per year is not sufficient to create substantial decreases in alcohol sales to underage youth. Law enforcement agencies should be encouraged to conduct more frequent checks.

DISCUSSION OF FINDINGS

In summary, extant literature on RBS training provides mixed evidence of modest effects for these programs. Eight studies show effectiveness of reducing alcohol consumption and the number of intoxicated patrons leaving an establishment. Ten studies show improvements in server knowledge and beliefs, but these improvements inconsistently translate into changes in behavior. Inconsistent findings may reflect, in part, the varying quality of the RBS programs, both in terms of content and implementation. Early programs from the 1980s to mid-1990s largely focused on training servers and clerks. After limited effects emerged from these early programs, some scientists moved to increased focus on working with management to create policies and monitoring mechanisms within the establishment. However, trials of these second-generation programs are also now beginning to show little evidence of effect. Moreover, given modest effects in research trials, where implementation staff were likely to be of higher quality and more motivated, even smaller effects are likely in typical implementations in non-research settings.

States with mandatory RBS training can have more consistent, quality implementation, and, therefore, better public health outcomes might be expected (Dresser and Glicksman, 1998). However, many current laws are not optimally designed, do not ensure quality training, and do not ensure all servers are consistently trained, or retrained periodically (Mosher et al., 2002).

Enforcement provisions of the laws also are clearly important, including of active monitoring of both training programs and trainee compliance, and adequate enforcement staff.

Direct enforcement of laws prohibiting sales or service of alcohol to underage or intoxicated patrons is also critically important. Results from the CMDA trial clearly highlight the positive outcomes regarding sales to underage youth that can be achieved with regular enforcement checks (i.e., several times per year). There is a paucity of literature on the effects of enforcement against sales to intoxicated patrons. Enforcement of over service regulations may require greater time, effort, and cost than enforcement of underage sales laws. Essentially no work has yet been done designing, developing, pilot testing, or evaluating alternative specific procedures for enforcing laws against sales to intoxicated persons. There is a clear need for the basic technology development of practical procedures for enforcing over-service regulations. Intoxication creates extremely high risk for a wide range of injuries, health effects, and social disruption. Therefore, enforcement of laws and regulations on over-service deserves much more attention.

The extant literature provides little support for effectiveness of RBS training programs alone. However, provision of training programs may be a prerequisite to implementation of more intense successful enforcement efforts, because states and communities may be reluctant to conduct active enforcement and impose substantial penalties for law violations without first providing notice and help to establishments in meeting their obligations (Wagenaar et al., 2005a).

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Detecting Alcohol Impairment by Observation of Intoxication

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The Wagenaar and Tobler (2006) paper has highlighted the need for countermeasures to curtail the number of alcohol impaired patrons departing on-site beverage establishments, which supply nearly half of the alcohol impaired drivers on the road. Their review of evaluation studies of responsible beverage servers and enforcement programs dealing with underage youth and intoxicated patrons illuminated the diverse problems involved in the interventions and the resulting modest results.

This paper will only discuss problems inherent in countermeasure programs designed to deal with intoxicated patrons. I will suggest that identifying impaired drivers by signs of obvious intoxication is a very difficult task. Moreover, intoxicated individuals are only a minority of the alcohol-impaired drivers on the road from on-site drinking establishments whose presence we wish to curtail.

One of the most informative descriptions of the relationship between components of obvious intoxication and blood alcohol concentration (BAC) can be found in a monograph by Erik Widmark (1932) of Lund University. At that time in Sweden, prosecuting a driver for driving under the influence (DUI) of alcohol required a police physician administer seven behavioral tests to determine if a driver was under the influence of alcohol. Table 1 presents Widmark's compilation of test results on 562 drivers examined by more than 150 physicians throughout Sweden after arrest for accident involvement or severely impaired driving. Note that the BAC is in grams per liter rather than in the U.S. standard of grams per deciliter, which requires shifting the decimal point mentally over to the left by one place.

The behavioral tests included alcohol odor, Romberg body sway test, walking a straight line, turning, finger-to-finger test, picking up small objects, and impaired speech. Only when drivers were above .15% BAC were the majority of these drivers considered under the influence. Moreover, the most sensitive test for alcohol was alcohol breath odor, which would be irrelevant as a clue to an alcohol beverage server in a bar. Only above .26% BAC were 100% of the drivers considered impaired.

A study by McGuire (1986) in California compared the percent of persons arrested when stopped at alcohol checkpoints with the BAC distribution found at roadside surveys in the same area. McGuire's paper indicated that only 21% of drivers with a BAC of .10% or above (the legal standard at that time) were arrested.

A more recent study by Wells et al. (1997) in North Carolina had researchers obtaining BACs from individuals who had been passed through a roadside police alcohol checkpoint. Sixty-two percent to 64% of DUI drivers above .08% were not detained at the checkpoints depending on BAC. Thus, only one of three DUI drivers was perceived by the police as under the influence.

A study by Urso et al., (1980) at the University of Pittsburgh Medical Center, inquired of ambulatory patients arriving at a hospital emergency center, who were either ill or injured, if they had recently used alcohol. Patients reporting alcohol consumption were evaluated as intoxicated, or not, by physicians using a simple behavioral test battery which included following a three-step command, performing arithmetical calculations, exhibiting no obvious neurological abnormalities, and evaluated as sufficiently responsible that they could leave without a third party accepting responsibility.

TABLE 1 Percentage Occurrence of Some of the Cruder Symptoms of Intoxication at Various Blood Alcohol Concentrations. (Reprinted with permission of Biomedical Publications from E. M. P. Widmark, *Principles and Applications of Medicolegal Alcohol Determination*, 1932; English translation by Biomedical Publications, 1961.)

Concentration in %	Diagnosis "influenced"	Alcoholic odor of the breath	Romberg's test	Uncertainty in walking		Finger- finger test	Picking up small objects	Stammering speech
				Walking straight	Turning			
0.01-0.20	0	0	0	0	0	0	0	0
0.21-0.40	0	0	0	0	0	0	0	0
0.41-0.60	0	0	0	0	0	0	0	0
0.61-0.80	0	33	17	0	0	0	0	0
0.81-1.00	30	63	47	6	31	18	0	0
1.01-1.20	40	81	50	6	30	15	21	9
1.21-1.40	46	78	52	4	24	27	33	14
1.41-1.60	68	82	60	15	51	32	40	30
1.61-1.80	79	84	67	25	56	42	43	25
1.81-2.00	88	91	74	29	62	52	45	35
2.01-2.20	93	92	82	36	79	58	59	48
2.21-2.40	96	93	83	33	73	68	69	50
2.41-2.60	97	92	82	36	77	57	50	57
2.61-2.80	100	100	78	55	100	57	71	60
2.81-3.00	100	100	75	57	86	71	86	71
3.01-3.20	100	100	83	33	67	67	60	67
3.21-3.40	100	100	100	100	100	100	100	100

The 65 patients declared nonintoxicated ranged in BACs from .12% to .54% with a group mean of .268%.

The few studies reviewed above are a sample of published papers which document the difficulty of assessing intoxication in drivers, even when examined by medical and law enforcement personnel who would be expected to be better trained and more motivated than most beverage servers. In general, the literature is in agreement with Widmark, that only above .15% BAC is it more likely than not that an individual would be perceived as intoxicated, and even above that, many drivers would escape detection.

Unfortunately, impairment is not the same as intoxication. Impairment and traffic collisions increase with any level of alcohol and increase strongly above 0.08% (Moskowitz et al. 2000, Moskowitz et al., 2002). Moreover, the number of drivers on the road with alcohol concentrations in the .08% to .15% BAC range, where detection of intoxication is difficult, is far greater even than the number of drivers above .15% BAC who would be more likely detected as obviously intoxicated.

Table 2 summarizes the BAC distribution of the roughly 7,600 control drivers in the Grand Rapids study (Borkenstein et al. 1974). 1.3% of the drivers had BACs between .08% and .149% compared to the 0.18% of the drivers at .15% BAC and above. Thus, 88% of the drivers above .08% BAC were below .15% BAC and difficult to identify by signs of intoxication.

Table 3 summarizes the BAC distribution of the Long Beach–Fort Lauderdale study, (Moskowitz, 2002). Of roughly 9,800 control drivers, 1.5% were between .08% and .149% BAC, and 0.5% were .15% BAC and greater. Thus, 75% of drivers over .08% BAC were below .15% BAC.

The data presented above suggests that limiting overconsumption of alcohol by on-site drinkers, based on observations by beverage servers of obviously intoxicated patrons, will continue to produce the modest results described by Wagenaar and Tobler (2006).

A similar problem with the use of subjective evaluations existed prior to the 1980s in obtaining court convictions of drivers arrested for driving under the influence of alcohol. In that period, neither most judges nor most jurists were convinced of the relationship between BAC and accident probability, independent of demonstrating through police officers testimony that the driver was obviously intoxicated. Defense attorneys were very successful in obtaining dismissals. The problem was only resolved when state legislators were convinced of the scientific evidence for the relationship between BAC and driving impairment, and passed legislation that permitted conviction based solely on drivers BAC level. It is the passage of per se laws that radically changed the conviction rate and increased the deterrence value of law enforcement.

Similarly, using beverage servers as vehicles to control excessive consumption requires providing the servers with more reliable methods for assessing the status of drinkers. Several of the studies reported by Wagenaar and Tobler relied on the servers counting the number of drinks patrons consumed, and this would certainly be a viable procedure. It's easy to broadly estimate body weight, and servers can be trained to apply a simple algorithm of weight, gender and age to determine the limits permitted for consumption. However, many establishments do not have easy methods for tracking how many drinks are being served to a patron, and the effectiveness of the

TABLE 2 BAC Distribution Among Control Subjects in Epidemiological Studies

BAC	% Drivers
0	89.01
.01–.079	9.5
.08–.149	1.3
.15 and above	.18
Percent of control drivers above .08% BAC who are below .15%	88

Grand Rapids Study (1962) N = 7,590 control drivers. Borkenstein et al. 1964, 1974; second edition prepared especially for Blutalkohol, 1974.

TABLE 3 BAC Distribution Among Control Subjects in Epidemiological Studies

BAC	% Drivers
0	88.7
.01–.079	9.4
.08–.149	1.5
.15 and above	.5
Percent of control drivers above .08% who are below .15% BAC	75

Long Beach–Fort Lauderdale (1999)—unpublished.

procedure will rest on new requirements imposed by legislation on alcohol serving establishments, such as giving each patron a card which gets punched when they get a drink, etc.

Alternately, we could train servers to administer a horizontal gaze nystagmus test. This is the only behavioral test which has been shown sensitive to the levels of alcohol we wish to use as maximum in drivers and which has a high degree of reliability. I believe it may be feasible to construct a device which could test this automatically in a few minutes.

A third alternative would be the use of portable alcohol breath testers. There is widespread acceptability of these devices. They are highly accurate, reliable and low cost. Behaviorally, they require at least a 15-minute wait after previous consumption, but that has value in itself.

Certainly other methods to assist beverage servers in detecting over-consumption can be suggested once it is accepted that simple behavioral observations for overt intoxication will fail to detect the overwhelming majority of alcohol impaired drivers. Only objective measures of beverage consumption, or objective behavioral or chemical tests can reliably identify over-consumption. Instituting such a new procedure in beverage establishments will require motivating the establishments, and educating the public. As with the institution of per se laws, legislation will surely be required.

It should be noted that the current U.S. alcohol limit of .08% BAC for driving is considerably higher than permitted by the majority of the industrialized nations internationally. These countries have heeded the advice of their scientific experts and established lower BAC limits. In the United States, the National Safety Council, the American Medical Association, and other scientific societies have recommended a maximum limit of .05% BAC. Assuming that U.S. laws will eventually move to these recommendations, dealing with limiting on-site consumption by subjective evaluation of beverage servers will become even more difficult, as drinking patrons between .05% and .08% BACs will exhibit even fewer overt symptoms than those above .08%. Moreover, the number of drivers between .05% and .08% BAC are greater than those drivers above .08%.

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Alcohol Law Enforcement *Agencies, Methods, and Impact*

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State alcohol beverage laws are among the most complex and convoluted laws in existence today. They are often reminiscent of societal attitudes and morals that in existence when Prohibition was established more than 80 years ago. Although many state legislatures have revisited some of these laws in the past 10 to 15 years, except for some slight modernizations, they remain generally intact. Yet despite their weaknesses, the laws and the agencies that enforce them remain important tools for society to achieve the broader goal of improved highway safety and protection of the public's welfare.

The men and women who enforce the nation's alcohol beverage laws recognize they are engaged in a balancing act. On one hand if they enforce the laws and regulations too aggressively then the agency and officers are subject to criticism and potential negative political exposure because they "don't understand the pressures of modern business people." On the other hand if they appear too understanding and enforcement seems lax then the agency and officers are criticized for bowing to industry pressure and not adequately protecting society from harms associated with alcohol sales. The strategies employed by alcohol law enforcement are quite advanced in their approach to the broad impact of alcohol in our society. This paper will explore some of the diverse agencies who enforce these laws and survey some of the promising prevention and law enforcement strategies being researched in this area.

OVERVIEW OF THE ALCOHOL BEVERAGE SYSTEM

With the repeal of the 21st Amendment the regulation of alcoholic beverages reverted to the individual states. Many states chose to resume the legal sale of alcohol through licensed private sellers. Eighteen states and a few local jurisdictions opted to retain control over the sale and distribution of alcohol.

The crime and corruption arising from Prohibition were clearly unacceptable, but so were the proliferation of saloons and the abusive drinking of pre-Prohibition days. What was needed was a new balancing of rights and responsibilities to better serve the community interest. States wanted to establish a retail network that would promote moderate, non-problematic drinking. At the same time, many states wanted a higher level of regulation and control to be in place to protect the public, which would inevitably bear the substantial social risks and economic costs of alcohol abuse.

One thing can be certain, when examining the various licensing and enforcement systems in place around the country, no two jurisdictions operate in the exact same manner. Each state and some counties have subtle distinctions ranging from their alcohol distribution systems to the emphasis placed on alcohol revenue. The power and authority of the enforcement personnel also varies from state to state. Enforcement personnel may possess full police powers, carry firearms, and wear a police uniform or they may wear civilian clothes and possess very limited regulatory authority.

CONTROL STATE SYSTEMS

Some states implemented a controlled distribution system that substituted the state for the private marketplace, eliminated economic incentives for maximizing sales, and put into place policies supporting moderate consumption. Opponents of control argued that any government intervention in the market was “un-American.” Advocates replied that the essential issue was not free enterprise but alcohol. In terms of the costs of its abuse, they pointed out, alcohol is “*suigeneris*,” i.e., in a class of its own.² Issues with exclusive and concurrent jurisdiction between state and local governments over the various statutory or ordinance provisions add an additional level of complexity to the unique systems of alcohol sales, distribution and enforcement. Control state systems also have regulations that determine not only the eligibility to sell alcohol but the sort of alcohol that can be sold by both on-premise and off-premise businesses.

There are great distinctions in how controlled jurisdictions approach their law enforcement responsibilities. For example in New Hampshire the Liquor Commission’s Bureau of Enforcement has concurrent jurisdiction with local law enforcement officers over the applicable alcohol beverage law provisions. The commission’s enforcement arm has exclusive jurisdiction over administrative cases presented to the commission for adjudication. Administrative cases are adjudicated by the three-member commission who determine if the allegations are supported by a preponderance of the evidence. They may impose fines, suspension, or both, of the license to sell alcohol. The New Hampshire system is subject to frequent criticism due to the perceived conflict that suggests an agency that operates 74 state-owned stores and who is charged to maximize revenue to the state may not effectively carry out their public safety obligation.

In contrast the State of Pennsylvania, which operates more than 600 retail outlets and is one of the largest purchasers of wine and spirits in the United States, has divorced their law enforcement mission in favor of a modified control system. In 1987 the Pennsylvania liquor code was transferred from the Pennsylvania Liquor Control Board to the Pennsylvania State Police. Unlike the New Hampshire system, administrative cases in Pennsylvania are adjudicated by an administrative law judge who determines if the allegations are supported by a preponderance of the evidence presented at a hearing. The administrative law judge may impose fines, suspension, or both, of the license to sell alcohol.

OPEN STATES AND LICENSE STATES

In those states that choose not to maintain “control” the open systems have some similarities and obvious differences. Administrators of open alcohol beverage control (ABC) agencies also assume a diverse role as law enforcers, tax collectors, and serving as guardian of industry trade practices to ensure a level playing field in the licensed community.

A two-state evaluation shows how distinct the systems can be in their common desire to regulate alcohol sales and enforce state laws. In California the California Department of Alcoholic Beverage Control (CABC) has exclusive authority in regulating the manufacture, distribution, and sale of alcoholic beverages. CABC maintains concurrent jurisdiction with local law enforcement for criminal violations of the California Government Code. CABC has

exclusive jurisdiction over any administrative sanctions against the licensee issued by the agency and their enforcement mission is carried out by trained peace officers employed by the CABC.

Administrative cases are initiated by the filing of an administrative complaint called “an accusation” when the CABC have evidence of a violation involving a licensee or a licensed premise has occurred. The licensee is entitled to have a public hearing on the accusation to present a defense against the charges made. The hearing will be presided over by an administrative law judge of the Administrative Hearing Office. The administrative law judge makes a proposed decision which is filed with the ABC director who may impose fines and loss of license.

In comparison, Massachusetts is a dual licensing jurisdiction. The top two tiers of the three-tier system are the exclusive jurisdiction of the Massachusetts Alcohol Beverage Control Commission (MABCC) who license and monitor manufacturer and wholesaler conduct and trade practices. The retail licensed community, which makes up the vast majority of all licenses issued in most states, is subject to licensure by a local city or town licensing board as well as a retail license issued by the MABCC.

Both the local licensing board and the MABCC have jurisdiction over the licenses they issue and both bodies may impose sanctions which may carry monetary fines, suspension, or both, of their respective license. The MABCC employs investigators whose job it is to enforce the state statutes and regulations adopted by the Commonwealth of Massachusetts. Local enforcement is performed by the city or town police department who are enforcing both state statutes and local ordinances on behalf of the local licensing board. Because Massachusetts is a dual licensing state, the licensee may incur two separate and distinct sanctions in the adjudication process.

Alcohol Law Enforcement’s Use of Prevention Strategies

Alcohol law enforcement at the state level is generally misunderstood and unappreciated for its positive impact on public safety and addressing quality of life issues. Those who have been involved with alcohol law enforcement recognize the importance of its multidimensional approach to alcohol-related crime and strategies that try to reduce over service and improve public safety. Enforcement officers are experienced in employing concepts of traditional policing as well as education of licensees and servers, prevention strategies, and environmental approaches consistent with the agency’s mission

Because state liquor law enforcement agencies are facing small and shrinking budgets, the assignment of enforcing alcohol laws is increasingly shifting to local law enforcement agencies. In 2004 the Madison, Wisconsin, police department attempted to quantify the impact of alcohol-related calls on their departmental resources. They estimated the department spent \$1.37 million responding to alcohol-related problems at bars and restaurants.³ Unfortunately, local agencies are often given the mandate to focus on “more serious crime,” not fully recognizing the link between alcohol sale and consumption and the costs to the department when limited resources are diverted from their intended purpose. Alcohol law enforcement’s diverse approach of prevention and enforcement should become more appealing to local police agencies as they struggle to maintain their over-extended resources. There are sources available for local police agencies seeking to get their arms around the impact of alcohol on their community.

In many cases, local law enforcement agents lack the specialized training and knowledge-based tools necessary for effective alcohol enforcement. In 1988 the National Liquor Law

Enforcement Association (NLLEA) was established in response to the lack of specialized training opportunities and the need for a forum to share strategies and professional development among the alcohol law enforcement community. NLLEA provides a specialized training academy for alcohol law enforcement professionals and meets annually to provide professional development for its membership.⁴ Local police departments may take advantage of this training resource.

In 2005, the National Center for Alcohol Law Enforcement (NCALE) was established to bring training and technical assistance to local police departments and demonstrate how the prevention strategies used by alcohol law enforcement agencies can be used as effective tools locally. NCALE's view is that adequate attention to alcohol laws by local police will improve compliance with existing regulation and decrease alcohol-related violence and its associated human, social, and economic costs to the community. NCALE serves local law enforcement across the nation as a source for information and expertise on alcohol-related crime and enforcement techniques.

The Problem-Oriented Policing Philosophy

Alcohol law enforcement applied the principles of problem-oriented policing (POP) before the approach received its name. POP is an approach in which discrete pieces of police business (each consisting of a cluster of similar incidents) are subject to microscopic examination by drawing on the specially honed skills of crime analysts and the accumulated experience of operating field personnel. This policing approach aims to discover new and more effective strategies for dealing with categories of problems based on what is freshly learned about each problem. POP places a high value on new responses that are preventive in nature, that are not dependent on the use of the criminal justice system, and that engage other public agencies, the community and the private sector when their involvement has the potential for significantly contributing to the reduction of the problem.⁵

In his work on alcohol-related harm Wiggers et al.⁶ laid the ground work for further research establishing the effectiveness of an alcohol-linking program to alcohol-related harm handled by law enforcement. Wiggers' goal was to align his research and the researcher with the police who were the end users in this project. As end users, the police would apply long-used alcohol law enforcement prevention measures to reduce alcohol-related crime. The alcohol linking program sought to improve the police collection of data and the application of the data to the enforcement of alcohol laws on the licensed premise.

Through a multidimensional approach to the issues of alcohol-related crime in New South Wales, Australia, Wiggers was able to bring his research to practice, and demonstrate that after 3 months there was a 15% greater reduction in alcohol-related incidents associated with the licensed community when a feedback-audit approach was used rather than the traditional reactive policing model. In addition to the adoption trial, Wiggers measured crime rates over a 6-month baseline period in 2002 with the same 6-month period in 2003 after the community policing strategies were adopted. The result was reduction of up to 22% in the number of intoxicated patrons in incidents following their consumption of alcohol on a licensed premise.

More than three quarters of the community sample indicted that the POP approach was acceptable as an effective and practical means of bringing about behavioral changes in the licensed community. Wiggers noted the likelihood of the alcohol-linking program to become institutionalized and continue to contribute to the reduction in harm was the capacity (and

willingness) of governments to provide resources to this form of policing activity. This study provides clear evidence to law enforcement managers that a comprehensive multidimensional approach of prevention and enforcement to alcohol related problems can achieve a better result than a single strategy on its own.

LAW ENFORCEMENT DETERRENCE

The evidence above suggests that changing the environment in which alcohol is sold and consumed and reducing access to alcohol can result in a reduction of crime and violence and the number of intoxicated patrons who were deterred from operating a motor vehicle. To achieve this result liquor laws must be enforced.

In 1995, the Champaign, Illinois, Police Department formed the Alcohol Enforcement Unit (AEU) to focus on enforcing alcohol laws to reduce alcohol-related crime. Champaign and its twin city Urbana share a large student population (nearly 40,000 students) from the University of Illinois and a community college. A major focus of the AEU's work has been underage drinking, particularly by those under the age of 19. The unit conducts targeted enforcement in the campus districts. Enforcement included bar checks, street sweeps, undercover operations in alcohol establishments, and retail compliance checks. The unit also works closely with licensees to improve compliance with underage drinking laws and develops bar employee security training programs.

Cooperative efforts with Illinois state agencies enhance the work of the Champaign AEU. The Illinois Liquor Control Commission regulates the licensing of retail liquor outlets and works with the Champaign AEU when conducting routine inspections and investigations of licensed establishments in the area. The commission also administers the Beverage Alcohol Sellers and Servers Education and Training program, which supports Champaign's efforts to reduce underage drinking and by educating liquor outlet owners and staff on state and local alcohol service laws. In addition, the Illinois State Police work closely with the local unit on bar and retail compliance checks.

These efforts appear to be producing positive results: between 1998 and 2001, the percentage of minors under the age of 19 arrested for alcohol-related violations decreased from 33% of all liquor law violations by minors to 24%⁷ (Table 1).

Further evidence that alcohol enforcement can have a positive effect on a community is indicated by the reduction of crime in Champaign, particularly in the campus areas targeted for alcohol enforcement. Between 1995, the year that the AEU was established, and 2001, violent crime dropped citywide by 26% (the same rate that violent crime decreased nationally). In the campus district, however, it dropped by 34%, and in the core campus (an area containing bar and restaurant venues that target college students), it dropped by 64%⁸ (Figure 1).

TABLE 1 Alcohol-Related Arrests of Minors

	1998	1999	2000	2001
All arrests for alcohol-related violations by minors	813	971	1,702	1,250
Arrests of minors under 19	267	296	384	302
Percent of arrests: Minors under 19	33%	30%	23%	24%

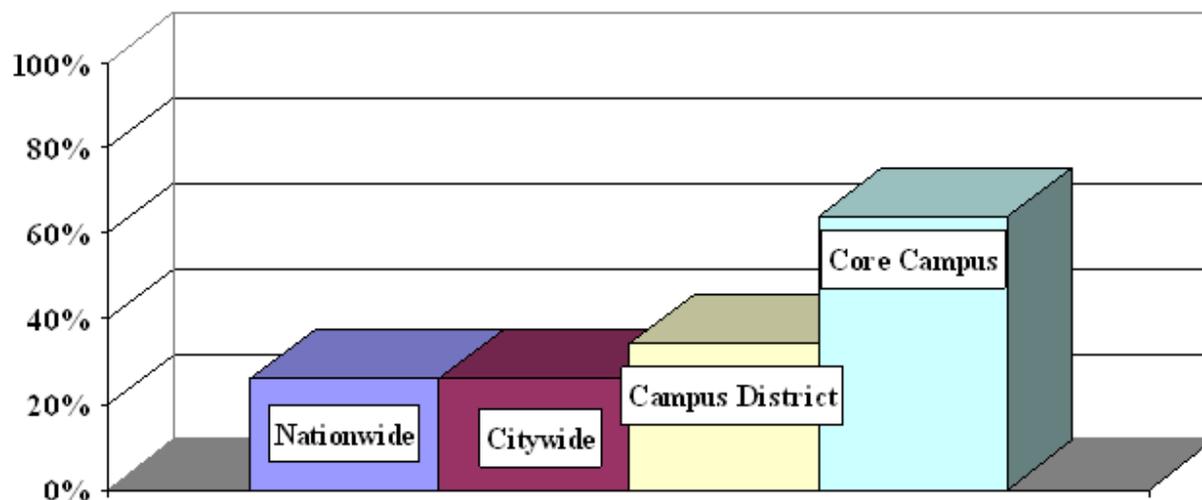


FIGURE 1 Decrease in violent crime: Champaign, Illinois, 1995–2001.

RESPONSIBLE BEVERAGE SERVICE INITIATIVES

Responsible beverage service (RBS) training is a prevention strategy that educates the servers and sellers of alcoholic beverages regarding the laws alcohol sale and service. RBS training also includes sharing techniques to reduce sales to minors and obviously intoxicated individuals and information about important principles of customer service when the provision of alcohol is involved. Many alcohol law enforcement agencies across the country have determined that RBS training is one of their core operational functions and they have developed sophisticated programs covering topics such as legal considerations, false identification, serving practices, and general liability.

Some states have adopted mandatory training of alcohol servers as a condition precedent to the issuance of a license to sell alcohol.⁹ Several of these programs outlined the legal responsibility of the licensee and the corresponding duties created by the various licensing jurisdictions. The business community, seeking to satisfy a need, expanded upon the legal approach offered by the states and added techniques and suggestions on customer service in an effort to create the broadest approach to responsible service of alcohol.

These programs have been offered in one form or another for nearly 30 years with little evaluation to determine if the programs were comprehensive in their scope and effective in content. Mosher et al.¹⁰ conducted a qualitative analysis of state laws governing server training programs across the country in an effort to determine how effective the laws are in mandating or encouraging high-quality RBS programming that has the potential for reducing alcohol-related problems. The researchers classified the states into two general categories. The first are states that have mandatory laws where training is a condition precedent obtaining a license. The second category is states that provide incentives for licensees who complete training. After examining five components of RBS laws¹¹, the states that were most effective in crafting policy were those that mandate training of licensees and servers and included a majority of the components in their program. After exhaustive analysis the researchers found the mandatory states generally rated

higher than the incentive states, but his conclusion generally found RBS legislation across the country to be weak.

Toomey et al. assessed an RBS intervention with licensees in a demonstration project called Project Alcohol Risk Management (ARM)¹². The goal of this project was to work with owners or managers to develop and implement establishment policies that encourage responsible alcohol sales and inform and discuss new alcohol policies with staff. The public health goal of Project ARM was to change establishment practices such as sales to minors and sales to intoxicated patrons that can lead to death, injury, and damage. Toomey concluded that community interventions such as ARM complement existing state or local law enforcement efforts. Toomey suggested that a strategy that implements the ARM intervention techniques within the context of increased enforcement levels and community pressures may motivate owners and managers to encourage responsible service of alcohol among their staff.

ALCOHOL LAW ENFORCEMENT POLICING METHODS

Minimum purchase age (MPA) laws are probably the best recognized alcohol laws in the country. MPA laws establish 21 as the legal age for purchasing alcoholic beverages. Since passage of MPA laws in all 50 states in the late 1980s, more than 17,000 alcohol-attributable youth traffic deaths have been avoided.¹³ All 50 states also prohibit the furnishing of alcohol to minors, although many states allow for exceptions to the law, perhaps most notably, furnishing by a parent or guardian.¹⁴ The most visible role for alcohol law enforcement is the enforcement of the MPA laws.

Of equal importance are the laws governing the sale of alcohol to persons who are intoxicated. The harm associated with dangerous or excessive alcohol consumption is well documented. At least 85,000 Americans die each year from alcohol-related causes, making alcohol-related problems the third leading actual cause of death in the United States.¹⁵ Drinking and driving accounts for a significant percentage of these deaths. In 2004, alcohol-related fatalities decreased for a second year, declining by 2.4% to 37.6%, falling below 17,000 to 16,694 for the first time in 5 years. States with the greatest percentage increase were Vermont (42%) and New Hampshire (34.6%). States with the greatest percentage decrease were the District of Columbia (-35.8%) and Rhode Island (-20.2%).¹⁶ Whether addressing the issue of underage drinking or the over service of patrons, police departments and alcohol law enforcement agencies must collaborate in order to achieve the best possible result for their efforts.

RETAILER COMPLIANCE CHECKS

A significant factor in all enforcement activity focused at the retail community is the notion of deterrence. With a lack of personnel dedicated to alcohol law enforcement at the state and local level, deterrence is an important part of the prevention approach used by those involved in alcohol law enforcement. The availability of the regulatory forum and administrative law venue provides alcohol law enforcement with a relatively quick and meaningful avenue to impose penalties when licensees have broken statutes, rules or ordinances.

A common law enforcement program used by both local and state officials is the alcohol compliance check. Compliance checks focus on the enforcement of the MPA laws that exist around the country. Research conducted during the mid-1990s found that after compliance checks were conducted, sales to underage patrons decreased from 60% to 80% to 25% to 30%.¹⁷

In 2004 researchers from New Hampshire looked at the trends associated with a pilot program that imposed more severe penalties against businesses that sold alcohol to underage during a compliance check.¹⁸ The study was conducted in Concord, New Hampshire, and examined data collected from 1999 to 2004. Before enhanced enforcement activities, 62 of 220 licensees (28.2%) sold alcohol to underage youths during compliance checks (Figure 2).

During enhanced enforcement, 39 of 383 licensees (10.2%) sold alcohol to underage youths during compliance checks. During enforcement checks elsewhere in New Hampshire, outside of Concord, 308 of 1,007 licensees (30.5%) sold alcohol to underage youths in compliance checks during October 1999 to February 2002 (Figure 3).

During March 2002 to February 2004, a total of 231 of 832 licensees (27.7%) sold alcohol to underage youths. The enhanced enforcement efforts of both the local police and the state alcohol law enforcement agency resulted in a 64% reduction in retail sales to underage youth in this community.

SALES TO INTOXICATED PERSONS AND EFFECTS ON HIGHWAY SAFETY

Historically the law enforcement initiatives for driving under the influence (DUI) have been centered on high visibility enforcement programs such as directed patrol and sobriety checkpoints to detect and apprehend the alcohol impaired drivers. These enforcement efforts are often combined with public information campaigns such as “Campaign Safe and Sober” (NHTSA) or “Tie One on for the Road” (Mothers Against Drunk Driving) to provide

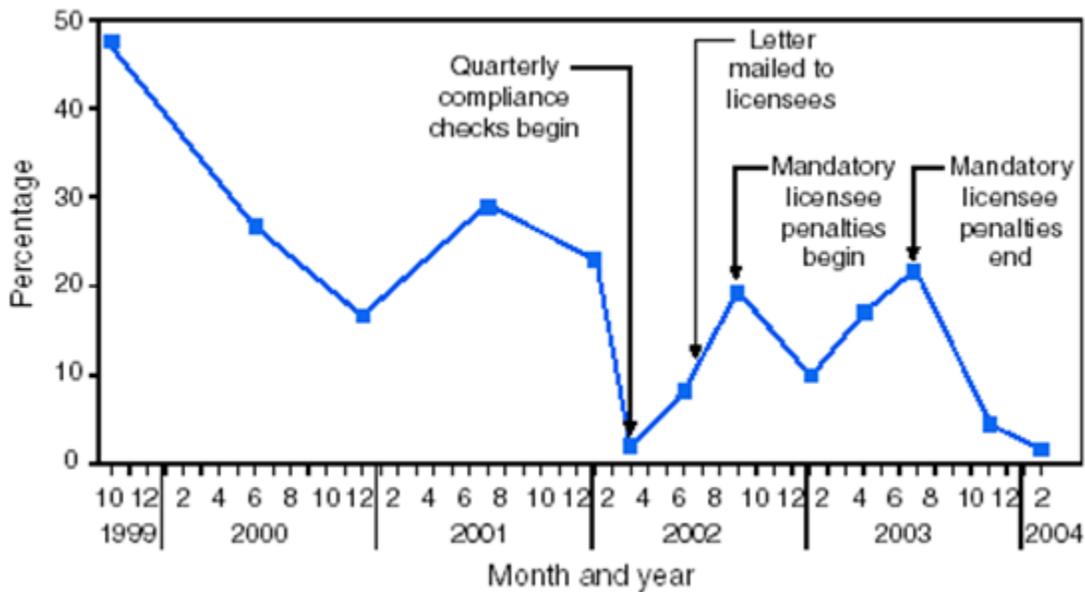


FIGURE 2 Percentage of licensees selling alcohol to persons <21 years during compliance checks, by month and year: Concord, New Hampshire, October 1999 to February 2004.

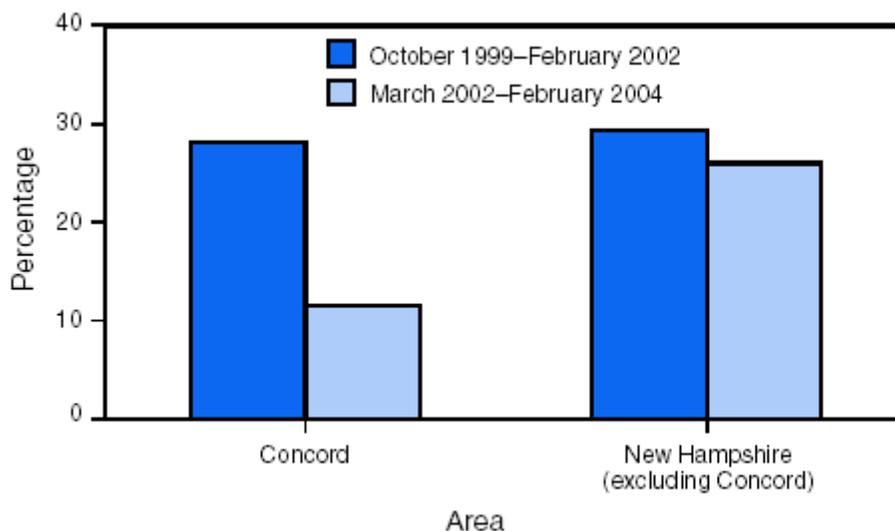


FIGURE 3 Percentage of licensees selling alcohol to persons aged <21 years during compliance checks before and during enhanced enforcement, by area: Concord, New Hampshire, October 1999 to February 2004.

information and serve as a deterrent to drinking and driving. Additionally, significant progress has been made to standardize the testing and evaluation procedures used by law enforcement in the field to better detect the drunk or drugged driver.

Studies have shown that up to 50% of persons driving under the influence had their last drink at a licensed establishment.¹⁹ In an effort to find promising strategies that address the issues of DUI at their root, NHTSA has funded research projects with the Pacific Institute for Research and Evaluation using the expertise of the NLLEA to research the impact of programming used by alcohol enforcement units from around the country. These studies will measure approaches long used in the alcohol enforcement community to determine their effectiveness and to measure their potential impact to reduce the incidents of over service of alcohol by the licensed community and to reduce the rates of driving while intoxicated (DWI) arrests and alcohol related crime.

A handful of states such as Oregon, Ohio, Massachusetts, and Washington engage in the collection of last drink data in an effort to determine where the drunk driver had their last drink. It seems logical that one critical component to addressing the drunken driving issue is to determine where the drunk driver has been drinking and when that source is a licensed premise to bring about RBS that conform to state law. One of these demonstration projects is the Washington State Liquor Control Board's (WSLCB) "Last Drink" data project. The WSLCB project analyzes monthly DWI arrest reports that identify last drink locations as well as the blood alcohol concentration levels of the arrested drivers. The WSLCB then contacts establishments identified as the worst offenders from this list to offer educational training to the licensees and their employees, and will conduct an increased number of premise checks and undercover operations, taking corrective action if necessary. Pacific Institute is partnering with the WSLCB to evaluate the effectiveness of this enforcement approach by conducting measurements of the rate of sales to pseudo-intoxicated patron before and after a 6-month intervention period. The final results are expected in September 2006 and will hopefully be used by alcohol law

enforcement to document the effectiveness of using this common sense approach to reduce over service and improve highway safety in an efficient and cost effective manner.

NHTSA has also developed curricula in a broad range of subject areas for law enforcement officers to detect the impaired driver. These training initiatives were created in response to law enforcement's need for standardized detection and evaluation tools to detect the drunk or drugged driver.²⁰ While NHTSA programming was largely focused on traditional police agencies, alcohol law enforcement has recognized the value of these standardized evaluation programs to the alcohol law enforcement mission. Alcohol enforcement units from states such as Massachusetts, Vermont, and New Hampshire have incorporated the evaluation programs of standardized field sobriety testing (SFST) and drug recognition experts (DRE) into their operational and training efforts to better detect and train enforcement officers and alcohol servers on the pharmacological issues of over service. It is not uncommon to have alcohol law enforcement officers from these states using SFST or DRE as tools in their investigations against a business accused of over serving a customer. NHTSA's training efforts to educate law enforcement and bring greater acknowledgement to alcohol law enforcement strategies that think outside the box have helped stimulate collaboration among agencies with a mutual interest in public safety.

STATE AND LOCAL LAW ENFORCEMENT COLLABORATION

Law enforcement collaboration often takes the form of a task force or other law enforcement coalition. Alcohol law enforcement is an important part of any law enforcement task force dealing with issues related to public safety generally and highway safety specifically. By example, over the past few years New Hampshire has moved towards integrating the alcohol law enforcement mission of the State Liquor Commission's Bureau of Enforcement into such task force groups as the Governor's Fatal Crash Commission, the Attorney General's Underage Drinking Task Force, and the Governor's Traffic Safety Commission. The presence of alcohol law enforcement broadens the scope of the work performed by these groups and alcohol law enforcement brings an additional perspective not otherwise represented by other law enforcement agencies.

In 1999 the New Hampshire Bureau of Enforcement was invited to participate in the annual Motor Vehicle Homicide Seminar sponsored by the New Hampshire Attorney General and cosponsored by the New Hampshire Police Standards and Training Council. The invitation was extended in order to inform local law enforcement about the bureau's mission and give details on how they could contribute to motor vehicle homicide cases. The training provided local police officials and prosecutors with information on the scope of what alcohol law enforcement can bring to an investigation. The bureau proposed that accident investigators and prosecutors "call out" alcohol enforcement officers when they suspected alcohol was a factor in a crash involving serious bodily injury or death. The rationale behind the proposal was that an alcohol enforcement officer at the scene brings another investigator to the case that has specialized knowledge relevant to the case and could aid in identifying the source of the alcohol. Additionally, alcohol law enforcement officers have access to licensee records and other pertinent information that is important if the case involves a licensed business.

In 2004 the strategy was tested when two students from the Holderness School in Plymouth, New Hampshire, were killed in a hit-and-run motor-vehicle crash. Under the direction

of Grafton County Attorney Rick St. Hilaire, the bureau was activated and an alcohol enforcement officer was dispatched to join the on scene investigation. In an effort to determine whether the driver had been drinking, and the potential source of the alcohol, the bureau officer was assigned to canvas the licensed businesses in the community. Within a few hours the officer determined that Anthony Begin was a customer of a business known as the Bull N'Bier House and that he left there in an intoxicated state at roughly the same time as the fatal crash. With this information officers from the accident scene went to Begins home and found vehicle damage consistent with the hit-and-run crash and arrested him for motor vehicle homicide. At the same time the bureau officer secured a written statement from the bartender and executed a search warrant to seize the video surveillance disk maintained by the business. The evidence showing Begin staggering off his bar stool and out to his car was instrumental in his subsequent conviction.

At the request of the bureau, Hilaire brought the facts of the case to a grand jury. Using the alcohol beverage laws in a previously unused fashion, Hilaire secured an indictment and subsequent felony conviction of the licensed corporation for serving Begin to the point of intoxication. This case set precedents in the New Hampshire on applicable legal theories as well as developing public policy now attaching criminal liability to businesses that over serve patrons and later become involved in incidents involving serious bodily injury or death. A second case involving the alcohol-related death of six people in a two-car crash awaits trial in the fall of 2006, and three under cases are under investigation at the time of this writing..

SUMMARY AND RECOMMENDATIONS

Research suggests that targeted enforcement of liquor laws, combined with training alcohol outlet employees, improving outlet policies regarding alcohol service practices, increasing community involvement, and implementing other prevention strategies can result in a reduction of alcohol-related violence, motor vehicle crashes, and other alcohol problems. Research also suggests collaboration among police departments and alcohol law enforcement agencies can enhance the effectiveness of existing law enforcement efforts and create a multiplier effect. We need further research that will build upon the results already reported and to develop new proposals that will broaden the scope of study and further analyze the effectiveness of alcohol law enforcement and its impact on public safety.

NOTES

1. Aidan J. Moore is the program manager for the Northeast Region for the National Center for Alcohol Law Enforcement (NCALE). Prior to joining NCALE he served as the Chief of Enforcement for the New Hampshire State Liquor Commission retiring after 25 years of service to the State of New Hampshire. Prior to joining the state he was local police officer in Portsmouth, New Hampshire. While in New Hampshire state government he served on the Attorney General's Underage Drinking Task Force, the Governor's Task Force on Fatal Accidents, and the Governor's Commission on Prevention and Treatment. He currently sits as a member of the Governor's Traffic Safety Commission in New Hampshire. He is a member of the New Hampshire Chiefs Association; International Association of Chiefs of Police, and is past president of the National Liquor Law Enforcement Association. Moore is a graduate of the 159th session of the Federal Bureau of

- Investigation (FBI) National Academy and the FBI LEEDS program. He is a graduate of New England School of Law and admitted to the bar in New Hampshire and Maine.
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**Enhanced Enforcement of Laws Prohibiting
Sale of Alcohol to Minors**
*Systematic Review of Effectiveness for Reducing
Sales and Underage Drinking*

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Task Force on Community Preventive Services

Authors' Note: *Points of view expressed in this paper are those of the Task Force on Community Preventive Services and do not necessarily reflect those of the Centers for Disease Control and Prevention.*

The deterrent approach to addressing alcohol-related problems is grounded in the theory that swift, certain, and severe punishment for an undesirable behavior will reduce its frequency. This approach has a long-standing and relatively successful history as the primary method of controlling alcohol-impaired driving (Ross, 1992) but it has been underused as a tool for deterring retailer establishments from selling alcohol to minors (Institute of Medicine, 2001; Wagenaar and Wolfson, 1995). One likely result of this lax enforcement environment is that minors report that they can easily obtain alcohol from retail sources (Jones-Webb et al., 1997). These data are reinforced by studies that indicate that between 40% and 90% of retail outlets sell to underage buyers (Institute of Medicine, 2001).

In most U.S. states, laws against the sale of alcohol to minors can be enforced both by local law enforcement agencies and by alcohol beverage control (ABC) agencies. In practice, however, ABCs often lack sufficient resources to adequately fill their enforcement role, and local law enforcement agencies often lack training in enforcing underage drinking laws and devote

their limited resources to other priorities (International Institute for Alcohol Awareness, 2005). One important program that attempts to address these resource limitations is the federal Enforcement of Underage Drinking Laws program, which allocates \$25 million in block grants to the 50 U.S. states and the District of Columbia to support enforcement of minimum legal drinking age (MLDA) laws, including laws against retail sales of alcohol to minors.

Retailer compliance with MLDA laws is enforced by recruiting youthful looking “decoys” to attempt to purchase alcohol without identification to prove that they are of legal age. These decoys may or may not actually be under 21; if they are over 21, however, they are generally judged to appear younger. If alcohol is sold to the decoy, the establishment is cited for its violation. Penalties may include criminal prosecution or fines and alcohol license sanctions administered by the ABC agency. Administrative sanctions generally increase in severity with each subsequent offense, and may range from an official warning to suspension or revocation of the retailers license.

ENHANCED ENFORCEMENT PROGRAMS

Programs to enhance the enforcement of retailer compliance with MLDA laws often have additional components to the enforcement efforts themselves. Given that the goal of such programs is to increase the perceived risk of detection to improve compliance with the law, many programs included a media component to publicize the increased enforcement efforts. These publicity efforts may involve paid or earned mass media; they may also involve sending letters to local establishments to inform them of the enhanced enforcement activities and caution them against selling alcohol to minors.

Enhanced enforcement programs are often conducted as part of a broader, community-based program to target underage or excessive drinking. These comprehensive programs are conceptually appealing because they can target demand for alcohol as well as channels for access to alcohol other than retailers. Thus, they may reduce the probability that minors will be able to easily obtain alcohol from other sources if retail purchase becomes more difficult.

INTERVENTION DEFINITION AND SCOPE OF REVIEW

In this systematic review, we evaluate the effects of programs that increased or intended to increase the frequency of retailer compliance checks in a community. To be considered in this review, these compliance checks needed to be implemented by or coordinated with local law enforcement or the local ABC agency, and to result in legal or administrative sanctions for violators. Studies also needed to evaluate at least one of our primary outcomes of interest: (a) the proportion of purchase attempts by decoys that resulted in sales and (b) measures of underage drinking. We included studies of interventions with multiple components if they included retailer compliance checks.

Methods

This review was conducted according to the methods developed for the *Guide to Community Preventive Services* which have been described in detail elsewhere (Briss et al., 2000). The articles to be reviewed were obtained from systematic searches of multiple databases, reviews of bibliographic reference lists, and consultations with experts in the field. The following databases were searched:

Econlit, PsycInfo, Sociology Abstracts, Medline, Embase, and EtOH. To be included in the reviews, a study had to

1. Be primary research published in a peer-reviewed journal or technical report;
2. Be published in English prior to July 2005;
3. Meet minimum quality criteria for study design and execution (Briss et al., 2000); and
4. Fall within the scope of the review as defined above.

For studies without comparison communities, study outcomes were expressed as percent changes relative to baseline; for studies with comparison communities, outcomes were expressed as percent changes in the intervention communities relative to changes in the comparison communities.

Results

Study Design and Intervention Implementation

We identified eight studies that met the inclusion criteria for this review (Barry, 2004; Grube, 1997; Perry et al., 1996; Preusser, Williams, and Weinstein, 1994; Scribner and Cohen, 2001; Wagenaar, Gehan, Jones-Webb, Toomey, and Forster, 1999; Wagenaar, Toomey, and Erickson, 2005; Wallin and Andreasson, 2004). Most of these studies were randomized controlled trials or other designs with concurrent comparison groups (Barry, 2004; Grube, 1997; Perry et al., 1996; Wagenaar et al., 2000; Wagenaar et al., 2005). Others were time series designs conducted within a single community (Preusser et al., 1994; Scribner et al., 2001; Wallin et al., 2004). Most of the enforcement efforts were targeted at establishments that sell alcohol for consumption off the premises; however, one study targeted both on-premises and off-premises establishments (Wallin et al., 2004). Follow up periods ranged from 1 month to 24.5 months with a median of 24 months.

Five of the studies evaluated intervention programs for which enhanced enforcement of retailer compliance was one of multiple components (Grube, 1997; Perry et al., 1996; Wagenaar et al., 1999; Wagenaar et al., 2005; Wallin et al., 2004). For most of these studies, it is not possible to estimate the specific contribution of the enhanced enforcement programs to the overall results; however estimates of the independent effects of these programs were possible in two of these studies (Grube, 1997; Wagenaar et al., 2005). The multicomponent interventions evaluated in this review were typically spearheaded by community coalitions, and frequently included training in responsible beverage service and attempts to change alcohol related policies. Two of these multicomponent studies were implemented in multiple communities, for which community coalitions had substantial autonomy in deciding on the specific approaches used to address problematic alcohol consumption (Perry et al., 1996; Wagenaar et al., 1999). As a result, only some of the communities evaluated in these two studies actually implemented enhanced enforcement programs.

Effects on Retailer Behavior

All of the studies included in this review evaluated the effect of enhanced enforcement on the proportion of attempted purchases by decoys that were completed by retailers. The results of these studies are presented in [Figure 1](#).

During enhanced enforcement programs, the proportion of decoys' buy attempts that were completed decreased by a median of 42% [interquartile interval (IQI): -57%; -17%].

All of the studies reviewed found that enhanced enforcement was associated with a decrease in sales to decoys. There was some variation in the magnitude of these effects, however, which may be partially due to substantive differences among the enhanced enforcement programs. Two important factors that may account for some of the differences among study results are the intensity of the enforcement programs and of their associated publicity efforts. Intervention intensity can be conceptualized as the percentage of retailers within the experimental community that received compliance checks, or as the number of repeat compliance checks to a given retailer over the course of the experimental period. Unfortunately, only two studies provided clear data on which intensity could be gauged. One study targeted all off-premises establishments in the experimental community at least once per quarter, and reported a relative 60% decrease in percentage of completed buy attempts (Barry, 2004). The remaining study also targeted off-premises establishments in the experimental communities on a monthly basis, and reported a relative 78% decrease in percentage of completed buy attempts (Perry et al., 1996). For each of these studies, both the intensity of enforcement and the size of effect appeared to be relatively high in comparison to that for other studies evaluated (for the remaining studies, the total number of enforcement visits ranged from 51 to 300 for medium to large cities).

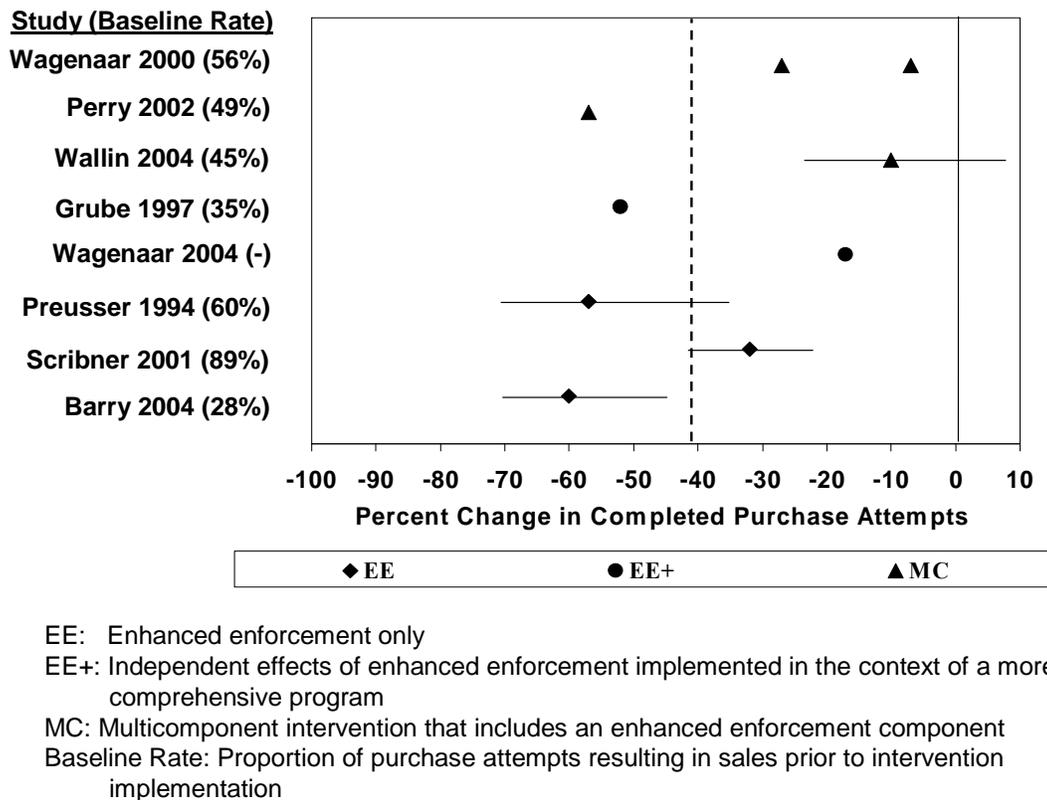


FIGURE 1 Percent change in the proportion of alcohol purchase attempts resulting in sales following implementation of an enhanced enforcement program, with or without complementary interventions.

We also evaluated the potential influence of more readily quantifiable factors, such as the duration of the enforcement programs. An analysis of the association between the time span between implantation of enhanced enforcement and the follow-up evaluation indicated that the intervention effects remain relatively stable over time during the period in which the enhanced enforcement program is active ($r = -.18, p > .05$). The results of this aggregated analysis are reinforced by those from individual studies that report outcomes at multiple time points during the intervention period, which also tend to show small increases in effectiveness over time. For example, one study examined the effect of enhanced enforcement over a 10 month period, and reported decreases of 47%, 56%, and 57% in completed buy attempts at 1 month, 3 months, and 10 months respectively (Preusser et al., 1994). A second study reported a 10% and 28% decrease in completed buy attempts at 2 years and 5 years respectively (Wallin et al., 2004).

In contrast to the finding of stable effects during the period in which enhanced enforcement is in place, results suggest that effects decay substantially if the enforcement efforts are discontinued. One study examined the establishment-level effects of an enhanced enforcement campaign for on- and off-premises establishments, and then modeled the decrease in the effect over the 2 years following exposure to the intervention (Wagenaar et al., 2005). This study reported that the effect substantially decays over this period for both types of establishments, and that the residual intervention effects approach zero for off-premises establishments. Another study found that within nine months after a one-time intervention, the rate of completed buy attempts had almost returned to baseline levels following a large initial decrease (Scribner et al., 2001).

In summary, the studies reviewed demonstrate that enhanced enforcement programs are consistently associated with a substantially lower probability that retailers will provide alcohol to minors. These changes in retailer behavior appear to persist during the period in which enforcement efforts are maintained. In contrast, the intervention effects diminish rapidly in the absence of continued enforcement.

Effects on Alcohol Consumption

Only three of the studies evaluated the effects of enhanced enforcement programs on underage drinking (Barry, 2004; Perry et al., 2002; Wagenaar et al., 2000). The first of these studies, using survey data on high school students in grades nine through 12, found that enhanced enforcement was associated with a 20% reduction (RR = .8; 95% CI: 0.7; 0.9) in both self reported alcohol consumption and binge drinking (Barry, 2004). This reduction in the enforcement community contrasts with a relatively stable statewide trend for underage alcohol over a comparable time period.

The remaining two studies evaluated the effects of multicomponent interventions on alcohol consumption, making it difficult to attribute observed changes to the enhanced enforcement alone. One of these studies assessed the effects of comprehensive community mobilization efforts on alcohol consumption among two groups, 12th grade students and young adults aged 18 through 20. This study found that the community mobilization (in which only one of the seven intervention communities was exposed to enhanced enforcement) was associated with a reduction in prevalence of any alcohol consumption of 2% ($p = .37$) for 12th graders and 7% ($p = .07$) for 18 to 20 year olds; for binge drinking prevalence, the community intervention

was associated with a 5% reduction ($p = .27$) among 12th graders and a 2% increase ($p = .60$) among 18 through 20 year olds (Wagenaar et al., 2000).

The final study assessed the effects of an intervention that combined an educational program with attempts to change the community environment (Perry et al., 2002); in this study, nine of the 12 intervention communities included an enhanced enforcement component in the intervention. Intervention effects were estimated by comparing changes in frequency of alcohol consumption for intervention and comparison cohorts between the 11th and 12th grade. Results were reported as growth curve estimates for consumption frequency assessed by self-report Likert scales. As expected, over this follow-up period both the intervention and comparison groups reported increases in frequency of alcohol consumption. These increases were lower in the intervention communities than in the comparison communities for both binge drinking ($p = .02$) and for overall alcohol consumption ($p = .07$), although the latter comparison did not reach statistical significance. The magnitude of the differences is difficult to assess directly based on the reported Likert scores; however, a conservative estimation method indicates that after one year, the intervention was associated with relative decreases of approximately 4% in frequency of alcohol consumption and 6% in frequency of binge drinking.

The results of these three studies generally indicate that enhanced enforcement programs are associated with beneficial changes in underage alcohol consumption. However, these results should be interpreted cautiously due to the small number of studies, the variability in effect magnitude, the incomplete implementation of enhanced enforcement in the community mobilization studies, and the difficulty in attributing the results to enhanced enforcement alone.

Applicability

The studies reviewed found evidence of substantial effects on retailer behavior for enhanced enforcement campaigns that were conducted in all geographic regions of the United States, in one non-U.S. setting, and in communities with varied racial and ethnic demographics. Benefits also generalized across both on-premises and off-premises establishments, and across communities with a wide range of baseline rates of retail sales of alcohol to minors. Thus, it is likely that these results will be applicable to most U.S. communities.

Other Positive or Negative Effects

No specific harms or benefits of enhanced enforcement programs were addressed in the studies reviewed.

Barriers to Intervention Implementation

Perhaps the most important barrier to implementation of enhanced enforcement campaigns to reduce sales of alcohol to minors is the perception that the community does not support such interventions. Without such support, there may be little incentive for regulatory and law enforcement agencies to increase their enforcement activities, particularly in the face of resistance from retailers (Wagenaar et al., 1995). The Institute of Medicine has proposed that the incentives for implementing and maintaining enforcement programs could be increased by making receipt of federal block grant funds conditional on achieving target rates of retailer compliance nationally. It may also be possible for concerned organizations to highlight the extent

of the problem of alcohol sales to minors in their communities by conducting their own decoy operations and publicizing the results (Willner, Hart, Binmore, Cavendish, and Dunphy, 2000).

CONCLUSION

According to the Community Guide rules of evidence, the studies evaluated provide strong evidence that enhanced enforcement of laws prohibiting sale of alcohol to minors are effective in limiting underage alcohol purchases. Further research will be required to assess the degree to which these changes in retailer behavior affect underage drinking.

DISCUSSION OF APPROACHES

There is strong evidence that the enhanced enforcement of laws prohibiting the retail sale of alcohol to minors is an effective method of reducing such sales. However, the retail channel is only one of many potential sources from which minors may obtain alcohol (Harrison, Fulkerson, and Park, 2001). It is possible that if access to alcohol is curtailed through an isolated enforcement program targeting retailers, minors may simply substitute retail sources of alcohol with social providers, such as friends, family, or strangers. Due to these potential substitution effects, it is likely that the effects of enhanced enforcement programs on underage drinking will be maximized if they are implemented as part of a more comprehensive approach to reducing underage drinking. Such a comprehensive approach would not only involve efforts to reduce access to alcohol from social providers, but also efforts to reduce drinking opportunities and demand for alcohol among young people (Institute of Medicine, 2001).

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The Importance of Alcohol Regulation at All Levels *Bringing It All Together—Lessons from Underage Drinking Controls*

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Laws can be powerful tools to change behavior to promote health. They are appropriate to employ when the health problem they target is important; there is evidence the law can reduce the problem; the law is minimally intrusive; there is no equally effective less intrusive alternative; the behavior being targeted affects other people; and, there is public support for the law. Impaired driving policy research can focus on the magnitude, dimension, and etiology of impaired driving, whether persons other than impaired drivers are affected, factors that may influence whether a law is passed, whether once enacted a law reduces impaired driving and related injury and death, and how to most effectively implement a law and how to build and sustain public support for effective implementation efforts. This chapter will examine these various types of policy related studies that target underage drinking and drinking and driving as examples.

CRITERIA FOR USE OF LAW OR POLICY TO PROMOTE HEALTH

Policies, regulations, and laws can be powerful tools to change behavior to promote health. However, they are not the only effective interventions that can accomplish this task. Several factors should be considered when trying to decide whether to pass and implement laws to advance public health goals.¹

First, the problem should be important. Clearly this requirement is met in the case of alcohol-impaired driving. Traffic deaths are the leading cause of death in the United States among persons ages two to 33 and alcohol is a factor in 40% of these deaths accounting for 16,674 in 2004 (1). Over 225,000 alcohol-related traffic injuries are reported annually by police, probably a considerable underestimate because of inconsistent testing for alcohol in non-fatal traffic crashes (1). Generally, the more serious the crash the greater the likelihood alcohol is involved. Approximately 5% of all traffic crashes involve alcohol but 9% of crashes resulting in injury involve alcohol as do 40% of fatal crashes (2).

Second, there should be evidence that the legislation being considered will be effective in reducing the alcohol-related crash problem in question. Researchers have found numerous legal changes to be effective in reducing alcohol-related traffic crashes. For a recent review see Hingson and Sleet (3). Laws effective in reducing alcohol-related traffic crashes through general deterrence or prevention of alcohol-impaired driving include increases in the price of alcohol (see “Alcohol Prices and Traffic Safety” by Young, p. 31) and raising the minimum legal drinking age (see “Minimum Purchase Age Laws: How Effective Are They in Reducing Alcohol-Impaired Driving?” by McCartt, p. 84), per se laws, reducing legal blood alcohol limits from 0.10% per se to 0.08% for adult drivers and 0.00% to 0.02% or zero tolerance laws for youth. Administrative license revocation laws that allow police to seize the driver’s license of persons apprehended while driving above the legal blood alcohol limit are also powerful legal deterrents because the actions can be swift and certain. As noted in the paper by Mosher, “Legal Framework for Alcohol Regulation in the United States” (p. 48), dram shop and social host

liability laws that hold bars and restaurants (dram shop) or other individuals in noncommercial situations (social host) liable for potential damages if intoxicated or underage persons are served or provided alcohol also have potential to reduce alcohol-related traffic deaths. A number of laws have also been found to be effective specific deterrents that reduce rearrests for alcohol-impaired drivers or subsequent alcohol-related crashes among persons convicted of driving while intoxicated (DWI). Use of ignition interlocks, vehicle or plate impoundment, or immobilization and mandated treatment of persons convicted of driving under the influence (DUI) have all been effective as specific deterrents.

Third, the law should be minimally intrusive and should not be invoked if less intrusive measures are equally effective in reducing alcohol-related crashes. If educational, clinical, or engineering interventions alone can accomplish as much reduction in impaired driving and related inquiries or deaths, then legal changes may not be necessary.

Fourth, the behavior in questions should pose a risk to others. Clearly, impaired driving meets that criterion. Forty percent of persons who die in crashes involving drivers who had been drinking are people other than the drinking driver (2). Further, the younger the age of a drinking driver involved in a fatal crash the greater the percentages of people who are fatally injured other than the drinking driver. Half of the people who die in crashes involving drinking drivers younger than 21 years of age who had been drinking are people other than the drinking drivers, either passengers in the same vehicle, or in other vehicles struck by the drinking driver or cyclists or pedestrians (4).

Finally, the public should support the law. People are less likely to comply with unpopular laws and lack of compliance reduces their effectiveness which in turn undermines the rationale for a law.

FOCI OF ALCOHOL POLICY RESEARCH

Research on alcohol policy can have many different foci. Research can focus on magnitude, dimensions, and etiology of impaired driving. Much research has focused on the social demographic and psychological and personality characteristics of people who drive while impaired by alcohol. Males and persons 18 to 34 are more likely to drive while impaired (2)². Persons who exhibit antisocial personality traits or conduct disorder are more likely to drive under the influence of alcohol (5). Use of alcohol in hazardous situations is one of four criteria for diagnosis of alcohol abuse (6). It is also the criteria most often met in classifying people as alcohol abusers and most who meet these criteria do so because they drive after drinking. Alcohol dependence also predicts DUI. According to data from the National Longitudinal Alcohol Epidemiology Survey based on interviews with 42,000 adults 18 and older in a national multistage probability, 72% of people who reported being in a motor vehicle accident because of drinking during the year of the survey met alcohol dependence criteria at some point in their lives(2)². Fifty-nine percent were alcohol dependent during the year of the survey. Also the younger people are when they start to drink start to drink, the greater the likelihood they will being a motor vehicle crash because of drinking both during adolescence and adult years (7). Much of that relation is attributable to alcohol dependence. Grant and Dawson (8) reported that, based on the NLAES study, the younger people are when they begin to drinking the greater the likelihood they will develop alcohol dependence. Over 40% of persons who start to drink at age 14 or younger develop alcohol dependence compared to only 10% who start at age 21 or older.

This relationship has been found among persons with and without a family history of alcohol dependence (8) and after controlling analytically for age, gender, race–ethnicity, education, marital status, history of cigarette and drug use, and family history of alcoholism (9). The relation has also been found in other cross-sectional studies in Canada which has a lower legal drinking age than the United States (10) and in longitudinal studies (11, 12).

The National Epidemiologic Study of Alcohol Related Conditions included a survey of over 43,000 adults 18 and older conducted with in person interviews with a multistage national probability sample in 2001–2002, response rate 81%. Analyses of that survey found that the younger people are when they begin to drink the greater the likelihood they will develop alcohol dependence within 10 years of drinking initiation and by age 25 (13). Of persons who ever became alcohol dependent, 47% were diagnosable before the legal drinking age of 21 and two-thirds before age 25. Further, persons who develop alcohol dependence at a younger age are less likely to seek alcohol treatment after controlling for the numbers of dependence symptoms they meet. They are also more likely to exhibit features of chronic relapsing dependence characterized by experiencing more dependence episodes, episodes of longer duration, and more dependence symptoms (12). Analyses of the same database indicated that early age of first alcohol use is associated with a similar pattern of having a greater likelihood of experiencing alcohol abuse, abuse at an early age, multiple abuse episodes, abuse episodes of longer duration, meeting multiple abuse criteria (13) and a lower likelihood of seeking alcohol and a lower likelihood of seeking alcohol treatment despite the number of abuse criteria met by respondents (14).

Alcohol policy research also can help quantify the effects of drinking and driving on people other than the drinking driver. As mentioned earlier, 40% of people who die in crashes involving drinking drivers are persons other than the drinking driver and the related cost to society in terms of medical care expenses and lost work productivity have been placed at \$45 billion annually (15).

Alcohol policy research can help identify factors that may influence whether legislation is passed. For example, Wolfson et al. (16), analyzed what characteristics of Mothers Against Drunk Driving (MADD) chapters were associated with early passage of the Minimum Legal Drinking Age 21 (MLDA) law, he found that MADD chapters located in the state capitol, with drunk driving victims as the chapter directors, who had a higher ratio of victims versus other chapter members were more common in states early to pass the MLDA of 21. Of note, the amount of income raised by the chapter was not an independent predictor of MLDA 21 passage.

As noted earlier in this chapter a critical type of alcohol policy research and the type which has received the most research attention are studies that evaluate the effects of the passage of drinking driving laws and alcohol policies on the frequency of impaired driving and rates of alcohol-related motor vehicle crashes. Numerous types of study designs have been used in these analyses:

1. Single state pre-post law analyses often using time series analyses of alcohol-related fatal crash trends;
2. Quasi-experimental comparisons of single states passing laws with similar states that do not pass legislation;
3. Multistate analyses comparing multiple states that adopt a law with multiple similar states that do not; and

4. Multistate analyses that use regression or others econometric techniques that control for other DWI and traffic safety laws whose passage and enactment in close temporal proximity to passage of the DWI law under study may confound the laws effects.

Other key potential confounders often conducted in these types of studies include passage of other policies to reduce drinking and driving, alcohol sales or per capita alcohol consumption, unemployment rates or other measures of the economy over time, demographics of the driving population, related risky motorist behavior such as speeding, failure to wear safety belts, and other alcohol policies. Because randomized trial of state level general deterrence laws are not feasible, efforts to identify and control for potential confounders through study design or analysis are key in these studies.

Process components that assess publicity, education and public awareness of these laws, perceptions of the extent and nature of police and court enforcement, and which assess actual levels of apprehension, arrest and conviction can strengthen the interpretation of these studies.

Often researchers will attempt to triangulate data from multiple sources, self-report surveys, roadside observational surveys, media monitoring, arrest and conviction monitoring, crash, injury crash, and fatal crash data to see if plausible consistency in findings is found across multiple types of data. Because most drivers in fatal crashes are tested for alcohol, studies of the effects of DWI laws can examine whether fatal crashes involving alcohol decline relative to those that do not involve alcohol. This is very useful in that it helps to isolate the effects of DWI laws on alcohol-related fatal crash trends independent of other exogenous variables and/or secular trends that may influence crash rates in general, e.g., weather, road way environment, vehicle mix, and design and traffic volume. Examination of crash rates per licensed driver, registered vehicle or miles driven is another approach to control for these factors.

Alcohol policy studies can examine not only laws passed and enacted through the legislative process, they can also examine the effects of court decisions in lawsuits and case law. (See Mosher's chapter on dram shop laws and social host liability, p. 48.) Wagenaar and Holder (17) found that damages awarded in a verdict against a bar in Texas that served alcohol to an intoxicated person who on his way home from the bar was involved in a fatal crash resulted in changes in service practices and reductions in alcohol-related fatal crashes.

Alcohol policy studies have also examined how to most effectively implement laws once they have been enacted. For example, Blomberg (18) conducted a quasi experimental in Maryland after passage of a zero tolerance law there. Comparing two counties that implemented vigorous public information and heightened enforcement efforts to two other counties, he found the two counties with intense publicity and enforcement had one-third greater decline in "had been drinking" crashes in the targeted age groups.

As we will describe later in this paper, several experimental and quasi experimental studies have examined the effects of comprehensive community interventions that organize multiple departments of city government, e.g., health, school, police, alcohol beverage control (ABC), and parks and recreation as well as concerned private citizens and organizations. These communities typically implement multiple types of interventions, e.g., school-based education strategies to involve parents, media advocacy heightened police enforcement of existing DWI laws, and other environmental efforts to reduce alcohol availability. Other community organizing efforts and the development of community task forces are a key part of these efforts. The Community Anti-Drug Coalition of America has identified more than 5,000 coalitions across the country that seeks to reduce alcohol and drug related harms in their communities (19).

A final type of alcohol policy research that has received minimal attention but that warrants expansion is determining how best to build and sustain public pressure for effective and comprehensive law enforcement of alcohol policies. Many alcohol policies such as the minimum legal drinking age of 21 or zero tolerance laws are not actively enforced in many communities and even highly effective, legal drunk driving enforcement countermeasures, such as sobriety checkpoints are dramatically under utilized in the United States (20).

THE HADDON MATRIX AND POLICIES TO REDUCE ALCOHOL-RELATED TRAFFIC DEATHS

William Haddon, first administrator of NHTSA and author of some of the earliest case-control studies on alcohol's role in traffic and pedestrian deaths, developed a matrix for identifying and analysis of factors that can prevent traffic deaths (21). Following the public health paradigm of "Host, Agent, and Environment" he identified "Human, Vehicle, and Roadway Environment" factors that could influence traffic deaths. He also noted that interventions to prevent traffic deaths can occur prior to, during, or following a motor vehicle crash.

Most of the alcohol policies described in this conference focused on precrash prevention through interventions that influence human factors (the driver) and environmental factors (the roadway). Policies that influence alcohol availability such as price, minimum legal purchase age, and DWI laws meant to deter drinking and driving all target human precrash behavior. Alcohol outlet density, on hours and days of sales and service, responsible beverage service (RBS) laws all, and open container restriction laws can influence whether alcohol reaches the roadway environment.

As Hans Laurell indicated in his presentation, Sweden is considering the required installation of ignition interlock devices on all cars sold in Sweden. This is consistent with their very low legal blood alcohol limit of 0.02% for operating a motor vehicle. If enacted, this intervention would target vehicle design prior to a crash. Yet, most cells of the Haddon Matrix were not included by policies on the agenda of this conference.

Many interventions at the time of a crash and following the crash can influence alcohol-related traffic deaths. Use of safety belts reduces the risk of death or injury in a crash by approximately half. Yet persons who drive after drinking are least likely to wear belts. One study in California (22) studied the effects on the proportions of motorists wearing safety belts when California went from a secondary belt use law where police could only stop vehicles for a moving violation other than failure to wear safety belt, to a primary enforcement law, where a vehicle could be stopped if an occupant was unbelted. Young motorists and those who drove after drinking had the greatest proportional increase in belt use. Among motorists overall there was a 20% post law belt use increase, but among young motorists those who drove after drinking the increase was 39% clearly underscoring the disproportional impact such laws might have on reducing alcohol-related traffic injury or death.

Trauma center screening for alcohol problems and counseling patients injured under the influence of alcohol could likewise be a post crash intervention that could prevent alcohol-related traffic deaths. Vehicle engineering and roadway design measures could likewise reduce alcohol-related deaths during and following motor vehicle crashes even if they do not directly influence drinking and drinking driving behavior.

POLICY RESEARCH ON UNDERAGE DRINKING IN THE U.S.

In the balance of this chapter, we will examine the use of law and regulation to reduce drinking by persons under age 21 and alcohol related harm to illustrate the variety of ways that research can contribute to effective public policy. Alcohol is the drug of choice among persons under 21. The percentages of 8th, 10th, and 12th graders who use alcohol (23) is more than double the percentages who use cigarettes or marijuana. Though persons under 21 drink less frequently than persons above 21, the average amount consumed on drinking occasions is substantially greater, 4.65 drinks (24).

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) has defined binge drinking as five or more drinks for men and four or more drinks for women over a 2-h period without also consuming food (25). This level of consumption would in an average male or female produce a blood alcohol level of 0.08%, the legal blood alcohol limit for adult driver in all 50 states. Thus the average total amount of alcohol typically consumed by persons under 21 produces a blood alcohol concentrations (BAC) level sufficient to produce intoxication.

According to the Youth Risk Behavior Survey, a national survey of U.S. high school students conducted in 2003 (26), 23% of U.S. high school students begin to drink prior to age 13. By the time those students reached age 17 they were seven times more likely than those who waited until age 17 to consume five or more drinks on an occasion at least six times per month. Based on this survey an estimated one million U.S. high school students engage in this frequent binge drinking pattern. Students in this group are much more likely to engage in a variety of behaviors that pose risk to themselves and others. Sixty-one percent report driving after drinking in the past thirty days and they are much more likely than non-drinkers to say they rode with drinking drivers in the past month 80% versus 13%.

Both behaviors of course increase their risk for being in a motor vehicle crash. Because these frequent binge drinkers are more likely to report that they never wear seat belts 18% versus 5% if they are in a crash they are more likely to be injured.

Epidemiologic research reveals that each drink consumed increases the fatal crash risk more for drivers under 21 than the same amount consumed by drivers above that age (27). A national study comparing drivers fatally injured in single-vehicle crashes to drivers stopped on a national roadside survey in the same states, on the same time of day and day of week (28) found that in all age and gender groups compared to sober drivers the same age and sex, those with BAC of 0.08% to 0.099% had at least an elevenfold increase of single-vehicle fatal crash risk. However, male drivers ages 16 to 20 in contrast at that blood alcohol level relative to same age sober drivers had a 51-fold increased fatal crash risk (28).

The human brain is still developing into the middle 20s. Some investigators have reported that compared with demographically matched alcohol dependent adolescents to other adolescents from similar communities adolescents who are alcohol dependent exhibit decrements in memory, spatial relations and planning and in magnetic resonance imaging studies exhibited less hippocampal development (29, 30). Whether these decrements preceded and contributed to the development of alcohol dependence and whether these decrements will resolve if drinking is curtailed are not known. It is also not known whether relative to older drivers there are specific different effects of acute alcohol impairment at comparable BAC's on divided attention, reaction, time, tracking glare recovery, etc., and whether chronic alcohol-related damage occurs with less or more alcohol exposure.

It is, however, established that chronic alcohol dependence during adult years is associated with visiospatial, executive, psychomotor and memory decrements (31) and smaller brain volume (32–34).

INTERVENTIONS TO REDUCE UNDERAGE DRINKING AND DRIVING

Several interventions have been identified through research to reduce underage drinking and/or drinking and driving. Interventions have been identified that are

1. Individually oriented,
2. Family focused,
3. School based,
4. Environmental, and
5. Community interventions.

INDIVIDUALLY ORIENTED INTERVENTIONS

These interventions focus on changing the knowledge, attitudes, beliefs, and behaviors of individuals. The most common individually oriented interventions are alcoholism treatment and screening, and brief counseling intervention to reduce drinking and related harms.

Alcoholism treatment for alcohol abusers/dependents has been associated with reductions in drinking driving offenses (35), trauma center and emergency department experimental studies of screening, and brief intervention counseling for alcohol problems among people who have experienced alcohol-related injuries, have been associated in drinking and driving and alcohol-related offenses, and alcohol-related injuries (36–38) focuses Monti (37) on patients presenting in a pediatric emergency department, average age 18.4 years. During the 6 months after receiving a 40-min brief motivational intervention those in the experimental group experienced one-quarter the drinking and driving occasions, fewer moving violations 3% versus 23%, and one-quarter the number of alcohol-related injury.

Brief interventions are short sessions designed to motivate people to cut down or stop drinking and alcohol-related behaviors. The period of time shortly after admission to trauma centers or emergency department, because of injury, is thought to afford a “teachable moment” for people after experiencing serious injury.

Annually, there are approximately 8 million alcohol-related admissions to emergency departments (39). Of those only 2.2 million are entered into patient records as alcohol-related. This is likely an understatement in part because laws in 28 states and the District of Columbia allow withholding of medical insurance reimbursement for treatment of people with alcohol problems.

Larimer et al. (40) recently identified 15 experimental studies using screening and individually oriented brief interventions that reduced drinking among college student populations.

Unfortunately, most adolescents are college age persons with alcohol use disorders who might benefit from the program, do not believe they have drinking problems and consequently are not exposed to these types of programs.

This implementation gap is heightened because fewer than half of pediatricians routinely screen adolescent patients for use of alcohol or other drugs and less than one quarter ask if they drink and drive. Pediatric medical care providers considerably under diagnose alcohol use, abuse, and dependence among patients ages 14 to 18 (41). According to the National Household Survey of Drug Use and Health about 1.5 million 12 to 17 year olds meet alcohol treatment only 14% receive it (24).

Analysis of the National Epidemiologic Study on Alcohol Related Conditions indicate 19% of 18- to 24-year-old college students meet alcohol abuse or dependence criteria but only 5% of them sought treatment in the past year (4).

According to a committee of the American Academy of Pediatrics (42) a variety of barriers inhibit screening and counseling for alcohol abuse in this age group of patients. These include:

- Time constraints associated with high patient volume;
- Inadequate reimbursement related to time and effort required;
- Physician fear of labeling patients and families;
- Inadequate training in substance abuse and addiction;
- Lack of dissemination of research supporting positive treatment outcomes and negative effects of failure to intervene; and
- Lack of information on how to access referral and treatment sources.

School-Based Interventions

Typically, school-based interventions to reduce drinking that rely solely on conveying information about the risks associated with alcohol use have had little impact on reducing drinking or delaying drinking onset (43).

The most effective school programs in reducing or delaying drinking have the following characteristics. They

- Are based on social influence models;
- Include norm setting;
- Address social pressures to drink and teach resistance skills;
- Include developmentally appropriate information;
- Include developmentally appropriate information;
- Include peer-led components;
- Provide teacher training; and
- Are interactive.

Effects of school-only programs are generally small and they are less effective with students who initiate drinking prior to age five or six.

One of the most effective school-based programs was the Life Skills Program (44–46). It began in junior high school with 30 sessions or curriculum on

- Drug information,
- Alcohol/drug resistance skills,

- Self management skills, and
- General social skills.

While it achieved beneficial effects on alcohol and drug use in high school, they did not persist after high school.

A recent review by Elder et al. (47) identified four studies examining six different school-based institutional programs that sought to reduce driving after drinking or riding with a drinking driver. All the programs provided information about the risks associated with these behaviors. Most also focused on skills development, in particular, life skills and refusal skills. Reductions in riding with drinking drivers were reported in several studies (48–52). Klepp (52) found a reduction in driving after drinking as did Harre and Field (50) for girls but not boys. Most of these studies relied on self report. Only Shope et al. (53) examined official records regarding moving violations and crashes.

Family-Based Interventions

Spoth (54) conducted a controlled trial which randomly allotted 206 families of 6th graders to the Iowa Strengthening Families Program, 221 families to the Preparing for Drug Free Years program, and 221 to control conditions. The Iowa Strengthening Families program was a 13-h seven-session program conducted at school. Parents and children received interventions separately and then together. The goals of the program were to improve parent–child relations, strengthen family communication skills, and increase child-coping skills. At the end of the 12th grade those students exposed to the Iowa Strengthening Families program reported half the percentage drinking to intoxication as the control group (55). Although less than 48% of eligible families participated in the study limiting its utility for general population level intervention, the study clearly showed that parents can be helped to control drinking among their children.

In a subsequent randomized control trial (56) of 7th graders from 36 rural Iowa schools received either the Iowa Strengthening Families program and the Life Skills Training program $N = 549$ or the Life Skills Training program only $N = 517$ or were in a control group $N = 453$. Two and a half years later weekly drunkenness rates among intervention students was one third lower than among the control students. The Life Skills Training program students had intoxication rates lower than control students at rates that approached but did not reach significance. It appears that family interventions combined with school-based interventions achieve reductions in drinking to intoxication that are greater than school interventions alone.

Environmental Interventions

This type of intervention seeks to limit access of certain population groups to alcohol and restrict the presence of alcohol in certain situations, e.g., operating a motor vehicle, boat, or airplane.

MLDA 21

The most widely studied environmental intervention to reduce drinking among young people was the increase of the legal minimum drinking age to 21. In 1984, half the states in the United States had a legal drinking age of 21 when the U.S. Congress passed legislation to withhold federal highway construction funds from states that did not raise the legal drinking age to 21. By 1988,

all states had enacted this legislation. According to the Monitoring the Future Annual surveys of High School Seniors from 1988 to 1993, the proportion of seniors who binge in any given month declined from 41% to 29% (57), a proportional decline of over one quarter. The percentage that binge drink has remained constant at the lower rate since that time. Since 1982, alcohol-related traffic fatalities among 16 to 20 year olds nationwide has declined 60% from 5,244 to 2,115 in 2004 (1). A review of 49 studies published in peer-reviewed scientific literature revealed that when states lowered drinking ages, they averaged a 10% increase in alcohol-related traffic crashes in the age groups targeted by the legal change. In contrast, when drinking ages were raised, on average, states experienced 16% decreases in alcohol-related crashes in the targeted age groups (58). NHTSA has estimated that every year 700 to 1,000 traffic deaths are prevented as a result of the MLDA 21 (59). O'Malley and Wagenaar (59) in a national analysis of the effects of the law reported it not only reduced drinking among persons under 21, those who grew up in states raising the drinking age to 21 drank less than when they were under 21 but also from age 21 to 21 (60).

It is remarkable that these effects were reached because enforcement of the age 21 law has not been lax in many states. Compliance check surveys of underage youth attempts to purchase alcohol reveal the 44% to 97% have little difficulty purchasing alcohol (61).

Further, there are a series of potentially important unanswered questions about the law. According to the Alcohol Policy Information System (APIS) (61), 21 states do not prohibit underage consumption, 13 states have family exemptions for consumption, 10 states permit consumption in locations where parents or guardians are present. The impact of closing those loopholes in MLDA on teenage alcohol-related traffic injuries, deaths, and on underage drinking warrants investigation.

Zero Tolerance Laws

All states have enacted laws which make it illegal for persons under 21 to drive after any drinking: zero tolerance laws. A comparison of the first eight states to adopt zero tolerance laws with eight nearby states revealed a 21% decline in the proportion of fatal crashes that were the type most likely to involve alcohol (single vehicle, night, fatal crashes) (63). Wagenaar et al. (64), 2001 found that in the first 30 states to adopt zero tolerance laws, relative to the rest of the nation, there was a 19% decline in the proportion of people under 21 who drove after any drinking, and a 23% decline in the proportion who drove after five or more drinks. Voas and Tippetts (65) examining states nationwide from 1982 to 1997 reported independent traffic death declines of 19% and 24% associated with the MLDA 21 and zero tolerance laws.

Unfortunately, like the MLDA, zero tolerance laws have not been vigorously enforced. Enforcement of zero tolerance laws is hindered in some states because their implicit consent laws require that either an arrest for DWI or probable cause for a DWI before the evidentiary test can be administered to prove a zero tolerance violation (66). Further, in some states such as New Mexico, the majority of teenagers are unaware of their state's zero tolerance law (66).

Price of Alcohol

Although there are some exceptions, the preponderance of research studies on the topic indicate that increases in the price of alcohol reduces drinking and alcohol-related crash involvement as well as sexually transmitted disease rates (67). Because young people lack discretionary income,

they are more sensitive to price increases for alcohol than older drivers and particularly alcohol dependent persons (68–71). Higher alcohol outlet density per geographic area has also been found to be associated with higher alcohol consumption, alcohol-related violence, and other crimes. This has been observed in cross sectional studies (73–78) and most recently in a prospective study in California (79).

Comprehensive Community Interventions

Of course, enactment of laws and environmental regulations by themselves does not produce optimal declines in adolescent alcohol consumption, drinking and driving, and other forms of alcohol-related harm.

A process of education of the public about the laws, how and why they will be enforced coupled with police and court enforcement is needed to help change public attitudes about alcohol and deter alcohol purchase attempts by underage drinkers, underage alcohol consumption, risky behavior after alcohol use such as drinking and driving and ultimately reduce alcohol-related injuries and traffic crashes. Highly publicized sobriety checkpoints are particularly effective law enforcement deterrents to drinking and driving. These types of educational enforcement efforts are most effectively implemented at the community level through comprehensive community interventions.

Comprehensive community interventions typically involve multiple departments of city government, e.g., health, police, education, alcohol beverage control, etc., as well as concerned private citizens and organizations. They also implement multiple complementary program strategies such as school-based education programs, mass media programs, media advocacy strategies, underage compliance check surveys, heightened enforcement of underage alcohol policies and drinking and driving laws, community organizing, and environmental policy changes (80).

Numerous examples of successful comprehensive community interventions have been reported from experimental and quasi-experimental studies (81–86).

The Communities Mobilizing for Change on Alcohol (84) was a randomized 15-community trial to reduce underage youth access to alcohol. Merchants recorded underage alcohol purchase attempts; beer kegs were prohibited at university homecomings; policies were implemented to discourage motels from permitting underage drinking parties; security was implemented at high school dances; model ordinances were passed to restrict underage drinking; and compliance check surveys documented the proportion of underage alcohol purchased attempts resulted in illegal sales to minors. Merchants and the public were notified of results and informed about potential fines and actions that would be taken on their license to sell alcohol if they were identified in subsequent compliance check surveys to sell alcohol to minors. The program resulted in an increase in the proportions of alcohol outlets checking for age identification and a one-quarter decline in restaurant and bar alcohol sales to youth and in the proportion of 18 to 20 year olds attempting alcohol purchase, 17% decline in the proportion of older teens providing alcohol to younger teens, a 7% decrease in the percent of persons under 21 who drank alcohol and a 14% decline in alcohol related injuries among persons 18 to 20 (84, 85).

The Community Trials Program (83) in two California and one South Carolina community include similar compliance check survey interventions to reduce underage drinking, sobriety checkpoint drinking and driving enforcement, alcohol outlet density reduction, community mobilization, and media advocacy and efforts to increase RBS. During the program

rates self-reported DWI were cut in half, a 10% to 11% decrease in single-vehicle night crashes were observed, and a 43% decline in emergency department alcohol-related crashes was recorded.

The Massachusetts Saving Lives Program (81) was a 5-year comprehensive intervention implemented in a community designed to reduce alcohol-related fatal crashes. The program included school-based education about drinking and driving, heightened underage drinking law enforcement, sobriety checkpoints, and other drinking–driving law enforcement, media advocacy and efforts to reduce risky driving behaviors disproportionately engaged in by drinking drivers, such as speeding, failure to obey traffic signals, wear safety belts or yield to pedestrians in crosswalks survey self-reported driving after drinking was reduced particularly among young drivers, safety belt use increased significantly, and the proportion of vehicles observed speeding was cut in half. This yielded a 25% traffic fatality decline and over a 40% decline in alcohol related fatal crashes with comparable declines observed in the 15 to 25 year old age group during the five program years relative to the rest of Massachusetts (81).

The A Matter of Degree Program (85) used these types of comprehensive community interventions to address the difficult resistant array of college drinking problems. College–community partnerships used environment strategies in five colleges and surrounding communities to reduce drinking problems including beer keg registration, mandatory responsible beverage service, police wild party enforcement, substance-free dormitories and residence halls, and alcohol advertising bans. The program achieved reduction in college student binge drinking, driving after drinking, alcohol-related injuries, and the proportion of college students who reported being assaulted by other drinking college students.

Finally, the Fighting Back Program (86) included five communities that were the first to combine environmental interventions to reduce alcohol availability with efforts to increase substance abuse treatment utilization. To limit alcohol availability youth compliance check surveys were implemented as was responsible beverage service training, police closing of problem liquor outlets, and bans on billboard alcohol advertising. To expand substance abuse treatment, sales taxes were increased and new treatment programs were implemented in courts, jails, health care agencies, and public housing. Screening and brief alcohol intervention were expanded in emergency departments and new inpatient and outpatient and recovery programs were implemented. During the 10 program years relative to the 10 previous years and to comparison communities in the same states, the Fighting Back communities achieved a 22% decline in fatal alcohol related crashes among all ages and a 26% decline among persons ages 16 to 20.

CONCLUSIONS

Policy and law are important public health tools to help change human behavior in an attempt to promote health. Law is appropriate to invoke when the problem in question is important, when a law can reduce the problem, when it is minimally intrusive, and not more intrusive than equally effective alternate strategies are, when the behavior in question harms people in addition to those who engage in the behavior and when there is widespread public support for the law.

As revealed in the Haddon Matrix, policies can reduce alcohol-related traffic fatalities and injuries through a focus on human, vehicle, and environmental factors prior to, during, and after vehicle crashes.

Research on alcohol policy can have numerous foci:

1. The magnitude and dimensions of the problem that prompt a need for policy change including what's affected by the behavior in question;
2. Factors that may influence whether a law can be passed;
3. Whether or not the law is effective in reducing the behavior in question and related morbidity and mortality;
4. Ways to most effectively implement a law such as educational and enforcement strategies;
5. Court and judicial decisions and how they can influence the impact of laws; and finally,
6. How to build and sustain public pressure to educate, enforce, and optimally implement a law.

With regard to harmful youth drinking, policy research with each of these foci has helped to stimulate passage of a MLDA of 21 in the United States and zero tolerance laws making it illegal for persons under 21 to drive after drinking any alcohol. Research also indicates underage drinking can be further reduced by interventions that focus on the individuals such as alcoholism treatment and screening and brief counseling interventions, School- and family-oriented interventions have reduced drinking as have environmental policy changes such as alcohol taxes, outlet density restrictions and drinking and driving and related traffic safety laws. In general, programs that have multiple targets of intervention are most effective and comprehensive community interventions have been shown to successfully integrate several levels of intervention to reduce underage drinking and related consequences.

Despite substantial reductions in underage alcohol consumption, binge drinking, and alcohol related traffic deaths associated with raising the legal drinking age to 21 and zero tolerance laws, underage drinking remain pervasive national problems contributing to alcohol related traffic deaths as well as unintentional and intentional injury deaths, risky sexual behaviors, illegal drug use, and poor academic performance. Whether ways can be identified to implement wide spread comprehensive community, intervention programs such as those already found through rigorous research to reduce underage drinking and related health problems is a profound challenge and will require new research in some of the least studied areas relative to alcohol policy. The formidable challenge is how to sustain sufficient public interest in these issues so that effective public policies can be identified, legislated, optimally implemented, and sustained over time on a widespread basis.

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APPENDIX A: WORKSHOP AGENDA

Traffic Safety and Alcohol Regulation
Transportation Research Board
Committee on Alcohol, Other Drugs and Transportation

National Academy of Sciences Beckman Conference Center
Irvine, California
June 5–6, 2006

MONDAY, JUNE 5

Moderator: Rob Foss, University of North Carolina

9:00–9:15 **Introductions, Overview of the Workshop**
Kathryn Stewart, Safety and Policy Analysis International

9:15–10:15 **Overview of Alcohol Regulation and its Impact on Traffic Safety**
Presenter: Joel Grube, Prevention Research Center

10:15–10:45 Discussion

10:45–11:00 Break

11:00–11:30 **Alcohol Price Controls and Traffic Safety**
Presenter: Douglas Young, Montana State University

11:30–12:00 Discussion

12:00–1:00 Lunch

Moderator: Barry Sweedler, Safety and Policy Analysis International

1:00–1:20 **Legal Framework for Alcohol Regulation**
Presenter: James Mosher, Center for the Study of Law and Enforcement Policy

1:20–1:40 Discussion

1:40–2:00 **Alcohol Regulation and the European Union: Effects on Road Safety**
Presenter: Hans Laurell, Swedish Road Administration

2:00–2:20 **Alcohol Policies in Latin America and the Caribbean**
 Presenter: Maristela Monteiro, PanAmerican Health Organization

2:20–2:45 Discussion

2:45–3:00 Break

3:00–3:50 **Minimum Purchase Age Laws: History, Contrasts, Erosion**
 Presenter: Anne McCartt, Insurance Institute for Highway Safety

Case Study: New Zealand Lowers Drinking Age
 Presenter: Kypros Kypri, University of Otago, New Zealand

Status of 14 Under-Age-21 Drinking Laws in the United States
 Presenter: Jim Fell, Pacific Institute for Research and Evaluation

3:50–4:10 Discussion

4:10–4:30 **Limits on Outlet Density and Location: Effects on Traffic Safety**
 Presenter: Paul Gruenewald, Prevention Research Center

4:30–5:00 Discussion

Adjourn

Reception at Hyatt Newporter

TUESDAY, JUNE 6

Moderator: Paul Boase, Transport Canada

8:30–9:10 **Limits on Hours of Sales and Service: Effects on Traffic Safety**
 Presenter: Evelyn Vingilis, University of Western Ontario

Case Study: The Effects of Establishing Closing Hours in Juarez
 Presenter: Robert Voas, Pacific Institute for Research and Evaluation

9:10–9:30 Discussion

9:30–9:50 **Dram Shop and Social Host Liability Laws: Effects on Traffic Safety**
 Presenter: James Mosher and Stacy Saetta, Center for the Study of Law and Enforcement Policy

9:50–10:15 Discussion

10:15–10:30 Break

10:30–11:00 **Responsible Beverage Service Practices and Traffic Safety**

Presenter: Alex Wagenaar, University of Florida

Detecting Alcohol Impairment by Observation of Intoxication

Presenter: Herbert Moskowitz, University of California at Los Angeles

11:00–11:15 Discussion

11:15–12:00 **Enforcement of Alcohol Regulation: Agencies, Methods, Impact**

Presenter: Aidan Moore, National Center for Alcohol Law Enforcement

**Enhanced Enforcement of Laws Prohibiting Sale of Alcohol to Minors:
A Systematic Review of Effectiveness**

Presenter: Randy Elder, Centers for Disease Control and Prevention

12:00–12:30 Discussion

12:30–1:30 Lunch

Moderator: Jean Shope, University of Michigan Transportation Research Institute

1:30–2:00 **The Importance of Alcohol Regulation at All Levels: Bringing
It All Together**

Presenter: Ralph Hingson, National Institute on Alcohol Abuse and Alcoholism

2:00–2:30 Discussion

2:30–3:00 Concluding Discussion

WORKSHOP COSPONSORS

**National Highway Traffic Safety Administration
Transport Canada
Pacific Institute for Research and Evaluation
International Council on Alcohol, Drugs, and Traffic Safety**

APPENDIX B

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