

Chapter 16

Interventions to Prevent Alcohol-Related Injuries

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16.1. INTRODUCTION

Alcohol, the most commonly used drug among adults and adolescents (Substance Abuse and Mental Health Services Administration [SAMHSA], 2004), is related to many adverse health outcomes, including injuries and deaths (Room, Babor, & Rehm, 2005). In 2001, excessive alcohol use was associated with approximately 75,000 deaths and 2.3 million years of potential life lost (about 30 years of life lost per death) (Centers for Disease Control and Prevention [CDC], 2004). While the magnitude of alcohol-related injury mortality is similar to alcohol-related chronic disease mortality, far more years of life are lost as a result of injuries because the injury deaths occur at a younger age (CDC 2004; Lunetta & Smith 2005). In addition, alcohol use and alcohol-related consequences among adolescents are associated with significant costs to society, as much as \$58 billion per year, with the three most costly domains consisting of violent crime (\$36 billion), traffic crashes (\$18 billion), and suicide attempts (\$1.5 billion) (Levy, Stewart, & Wilbur, 1999). Although the magnitude and costs of alcohol-related negative consequences such as injuries and violence have been well defined and described, much less is known about the most effective prevention and intervention efforts for reducing alcohol-related injuries and violence. However, a number of evidence-based prevention efforts are available. Some of the most effective options are increasing alcohol taxes, restricting alcohol availability, and laws and programs to reduce the occurrence of drinking and driving (Room et al., 2005).

This chapter briefly describes the magnitude of alcohol-related injuries in the United States, the mechanisms linking alcohol use and injuries, and the primary and secondary prevention strategies to reduce and prevent alcohol use and alcohol-related injuries. More emphasis will be given to alcohol-related traffic crashes and interventions because there is much more information available in this area.

16.2. ALCOHOL-RELATED INJURIES: MAGNITUDE OF THE PROBLEM

In 2001, there were 40,933 injury deaths associated with excessive alcohol use or binge drinking (CDC, 2004). Binge drinking, is typically defined as the consumption of 5 or more alcoholic drinks on a single occasion over a 2-hour period for a man or 4 or more drinks on a single occasion over a 2-hr period for a woman (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2004). Of these, 26,359 were unintentional deaths (13,878 traffic deaths and 12,233 nontraffic deaths) and 14,821 were violence-related (6,995 suicides and 7,826 homicides). In addition to the injury deaths for which alcohol was involved in 2002, an estimated 8 million people were treated in emergency departments for alcohol-related injuries (McDonald, Wang, & Camouge, 2004). Another study indicates that 7% of the 20 million emergency department injury admissions annually are alcohol related (Gentilello, Ebel, Wickizer, Salkever, & Rivara, 2005). A recent case crossover study (in which patients served as their own controls) showed that there is a 9-fold increase in the odds of injury among patients who reported consuming five to six drinks during a 6-hour period before the injury and a 17-fold increase among patients consuming seven or more drinks before the injury (Vinson, Maclure, Reidinger, & Smith, 2003). Moreover, a recent international study of injured patients in emergency departments found that patients with a blood alcohol concentration (BAC) of 0.08g/dL (the physiologic definition of binge drinking in the United States; NIAAA, 2004) were at least three times more likely to experience a violent injury than an unintentional injury; the study noted a significant dose-response relationship between the amount of alcohol consumed and the risk of violent injury (MacDonald *et al.*, 2005).

16.2.1. Mechanisms of Alcohol and Injury Risk

In a review of alcohol and injury research, Lunetta and Smith (2005) described several ways that alcohol can increase risk of injury. It can have a direct biological effect through the impairment of human performance by slowing the decision-making process, reducing visual acuity and adaptation to brightness and glare, dividing one's attention, changing perceptions, and increasing reaction time. It may also have indirect effects by increasing the sense of confidence, inhibiting self-control, and reducing the perception of and response to hazards. The link between alcohol use and involvement in violent behavior is seen in the disinhibition of norms and behavior in certain situations and contexts. This plausibly explains why some interpersonal interactions and disputes escalate to violent behavior when alcohol is involved (Parker, 2004). Under the influence of alcohol, people may be more prone to risk taking, which can increase the likelihood of injury and the likelihood that disagreements between people escalate to violent acts. Alcohol may also hamper decision making regarding safety (such as the use of seat belts, floatation devices, child car seats, and helmets) and assessing dangerous situations or places. For example, alcohol may affect judgment, leading swimmers and boaters into more dangerous situations and making it less likely they will wear floatation devices.

Alcohol may impair natural defense against hypothermia in cold climates and water, and depresses the cough reflex, increasing the risk of choking and

aspiration—a frequent contributor to alcohol overdose deaths. Alcohol also contributes to fall injury through its effects on postural control, balance, and gait. Under the influence of alcohol, people who fall may have less effective reflexes and thus may be unable to avoid head injury. Alcohol also increases drowning risk by increasing the likelihood of falling into water. Once in the water, the capacity to swim and resist cold temperatures can be reduced. Alcohol contributes to fire risk if an intoxicated person falls asleep while smoking. Also, people who have been drinking may be less likely to hear a smoke alarm or fire alarm (Lunetta & Smith 2005).

16.2.2. Alcohol-Related Violence

Each year, an estimated 2.7 million people are victims of a violent crime in which the perpetrators had been drinking, which represents one out of four of all violent crimes (Greenfeld, 1998). Alcohol use is common during the commission of violent crimes among probationers, jail inmates, and state prisoners who had been arrested for different types of violent offenses (Greenfeld, 1998; Roizen, 1997). Studies have generally found that the more serious the crime, the more likely alcohol was involved. Greenfeld (1998) reported that 15% of robberies, 26% of aggravated and simple assaults, and 37% of rapes and sexual assaults are perpetrated by drinking offenders. Leonard and Quigley (1999) found that physical domestic violence episodes, were four times more likely to involve a husband's drinking than were verbal aggression episodes.

Other research of emergency room populations, which more likely reflect the experiences of victims rather than of perpetrators of violence, show that the attributable risk of injury is greater for drinking before the injury event than for a particular pattern of drinking and that the risk is higher for violence-related injuries than for other types of injuries (Cherpitel, Ye, & Bond, 2005). Likewise, research on adolescent trauma patients shows that alcohol use is associated with injuries due to assault (Spain et al., 1997). For example, in 2001, there were an estimated 244,331 alcohol-related emergency department visits in the United States among young people aged 13–25 years; 58,136 visits were assaults, 21,065 visits were self-harm, and 163,537 visits were due to unintentional/unknown injuries (Elder, Shults, Swahn, & Strife, 2004d). However, visits due to assaults were over three times more likely to be alcohol related than were visits for unintentional/unknown injuries.

Research on high school students shows that frequent or heavy alcohol use increases the odds of involvement in physical fights, resulting in injuries to self and to others (Swahn, Simon, Hamming, & Guerrero, 2004). Relatively few studies have specifically examined co-occurring alcohol use and violence in community samples of adolescents. In particular, one study reported that among drinkers, 11% of boys and 6% of girls were involved in alcohol-related fighting in the past year (Bonomo et al., 2001).

Alcohol use is also linked with completed suicides (10–69%) and suicide attempts (10–73%) (Cherpitel, Borges, & Wilcox, 2004). It seems that the strongest link between alcohol use and suicidal behavior pertains mostly to acute use (within 6 hours of the attempt) (Borges et al., 2004). However, as with the link between alcohol use and interpersonal violence, the mechanism by which alcohol use facilitates suicidal behavior is not well understood.

16.2.3. Alcohol-Related Unintentional Injuries

Excessive alcohol is a contributing factor to deaths from many different types of injuries. According to the Alcohol-Related Disease Impact Software (ARDI), based on 2001 data, the alcohol attributable fractions are high for a number of acute causes of death (CDC, 2004). For example, the alcohol attributable fractions for deaths due to falls are 0.32, for fire-related injury deaths 0.42, for firearm injury deaths 0.18, hypothermia deaths 0.42, occupational- and machine-related injury deaths 0.18, poisoning deaths (not including alcohol) 0.29, and water transport deaths 0.18. However, because of the more comprehensive alcohol testing among fatally injured drivers, there is much more information about the epidemiology of alcohol-related motor-vehicle injuries than deaths from other types of injuries (CDC, 2005a).

Worldwide, alcohol is implicated in one quarter to two thirds of the 1.2 million road traffic fatalities annually (Peden *et al.*, 2004). In the United States, traffic crashes are the leading cause of death for people aged 1–34 years (CDC, 2005b). According to the National Highway Traffic Safety Administration (NHTSA) (2003b), 41% of motor-vehicle crash deaths were alcohol-related (*i.e.*, those in which a driver or pedestrian had a BAC greater than 0), and 35% were in crashes involving someone with a BAC of 0.08% or higher. Of the total number of people injured in traffic crashes, 9% were injured in alcohol-related crashes.

Of all alcohol-related crashes in 2002, 4% resulted in a death, and 42% percent in an injury (NHTSA, 2003b). In contrast, of the crashes that did not involve alcohol, 0.6% resulted in a death, and 31% in an injury. Many people other than drinking drivers are killed in crashes involving drinking drivers. In 2002, of those who died in traffic crashes involving a drinking driver with a BAC of 0.01% or higher, 44% were people other than the drinking driver: 7% were other drivers in vehicles struck by drinking drivers, 22% were passengers in vehicles with drinking drivers or that were struck by drinking drivers, 13% were pedestrians, and 2% were bicyclists (NHTSA, 2003b). In 2002, a total of 573 children younger than age 16 years died in crashes involving drinking drivers. Overall most child passenger victims were in the same vehicle driven by the impaired driver (Quinlan, Brewer, Sleet, & Dellinger, 2000).

In 2002, about 84% of the drivers who had been drinking and were involved in fatal crashes had a BAC at or above 0.08% (NHTSA, 2003b). Currently 0.08% is the legal blood alcohol limit for noncommercial adult drivers in all U.S. states. Impairment in driving skills begins with any departure from 0% BAC, and virtually all drivers exhibit some impairment on some critical driving measure by the time they reach a BAC of 0.08% (Moskowitz & Fiorentino, 2000). Experimental laboratory studies have reported several physical deficits experienced with a 0.08% BAC and below, including reduced peripheral vision, poor recovery from glare, poor performance in complex visual tracking, and reduced divided attention performance (*i.e.*, the simultaneous performance of two or more tasks, such as tracking, visual search, number monitoring, and detection of auditory stimuli) (Moskowitz & Fiorentino, 2000; Howat, Sleet, & Smith, 1991). However, driver simulation and road course studies have revealed poorer parking performance, poorer driver performance at slow speeds, and steering inaccuracy at BACs of 0.05% and higher, and roadside observational studies have identified increased deterioration of speeding and braking performance (Hingson & Winter, 2003).

Alcohol involvement in fatal crashes is disproportionately higher among males, Native Americans, some Hispanics (Mexican Americans), and people younger than age 44 years (NHTSA, 2003a). Alcohol is also disproportionately a factor in single-vehicle crashes, at night and on weekends. Moreover, impaired drivers are more likely to have prior driving while intoxicated (DWI) arrests, to have been speeding, and to be less likely to wear a safety belt (Hingson & Winter, 2003; NHTSA, 2003a, 2003b).

16.3. INTERVENTIONS TO REDUCE ALCOHOL-RELATED INJURIES

It is beyond the scope of this review to outline all the different individual and environmental factors that can reduce alcohol-related injuries and deaths. We, however, focus on interventions that can influence individual behavior and reduce involvement in violence-related or unintentional injuries. While most of the interventions listed pertain specifically to reducing alcohol-related motor-vehicle crashes (see also Chapter 4), we note which of the interventions have been found to also reduce other types of alcohol-related injuries and deaths (see Table 16.1). Five types of interventions are discussed:

- Individually oriented interventions to change knowledge, attitudes, and behaviors.
- Environmental interventions to reduce alcohol availability and to deter drinking and driving.
- Laws to deter alcohol-related injuries.
- Enforcement and education.
- Comprehensive community interventions designed to reduce alcohol availability and drinking and driving behaviors.

16.3.1. Individually Oriented Interventions

Alcoholism screening, treatment, and brief interventions are promising tools to prevent alcohol-impaired driving. Many, if not most, drinking drivers involved in alcohol-related fatal crashes are alcohol dependent or abusers (Hingson, Heeren, Winter, & Wechsler, 2005a). Currently, 32 states have laws that require people convicted of drinking and driving to be assessed for alcohol abuse or dependence and to attend alcohol treatment (Mothers Against Drunk Driving [MADD], 2002). Independent evaluations of mandated treatment of convicted drinking and driving offenders revealed that treatment reduces the incidence of repeat offences up to 9% more than standard sanctions, such as license suspension, revocations, and fines (Wells-Parker, Bangert-Drowns, McMillen, & Williams, 1995). Treatment strategies that combined punishment and group or individual therapy were more effective than any single approach for first-time and repeat offenders (Wells-Parker et al., 1995).

A review of alcoholism treatment studies in the United States concluded that alcohol problems (e.g., alcohol-related injury or job loss) among alcohol-dependent people who receive pharmaceutical treatment and/or counseling are reduced by two thirds and the consumption of alcohol is cut in half, (Miller, Walters, & Bennett, 2001). Reducing consumption and alcohol treatment have

Table 16.1. Interventions to Reduce Alcohol Related Problems^a

Intervention	Motor-Vehicle Injury	Non-Motor-Vehicle Unintentional Injury	Homicides	Suicides	Other Violent Injury
Individually oriented interventions					
Alcoholism treatment—drinking driving offenders	E				
Alcoholism treatment—general population	E	P		P	P
Trauma center, emergency department—brief intervention	P	P			
School-based interventions	P				
Environmental interventions					
Increased legal minimum drinking age	E			P	P
Zero tolerance—under 21 years	E				
Increased price of alcohol	E		P	P	P
Reduced outlet density					
Alcohol sales ban					P
Dram shop laws	P				
Keg registration	P				
Responsible beverage service	P				
Off-premise monopoly	E				
Server training	E				
Drinking driving laws					
Administrative license revocation criminal per se	E				
0.08% legal blood alcohol concentration	E				
Lower blood alcohol concentration of convicted offenders	E				
Impounding vehicles or license plates	E				
Ignition interlocks	E				
Sobriety checkpoints	E				
Mass media campaigns	E				
Comprehensive community programs	E				P

^aE = effective; P = promising; empty cell = insufficient evidence.

also been associated with reduction in drunk driving offenses, suicide attempts, domestic violence, falls, drinking-related injuries, and hospitalizations (Dinh-Zarr, Diguiseppi, Heitman, & Roberts, 1999).

Trauma center and emergency department studies of screening and brief intervention counseling among people presenting with an alcohol-related injury have shown reductions in alcohol consumption and alcohol-related injuries (Gentilello *et al.*, 1999; Longabaugh *et al.*, 2001; Mello *et al.*, 2005). These are important populations for interventions because research shows that trauma patients who test positive for alcohol on admission have a twofold elevated risk of subsequent injury death than those not testing positive for alcohol (Dischinger, Mitchell, Kufera, Soderstorm, & Lowenfels, 2001). Moreover, screening and brief intervention for alcohol problems in trauma patients is a cost-effective intervention (Gentilello *et al.*, 2005).

Larimer and Cronce (2002) reviewed individually oriented strategies to reduce problematic alcohol consumption by college students and found that several skills-based interventions, including self-monitoring, self-assessment, and brief motivational interventions, resulted in reductions in alcohol consumption. Another review (Elder et al., 2005) found that school-based programs that provided information to students about the risks of drinking and driving, life-skills development, and refusal skills reduced riding with a drinking driver but not drinking and driving itself.

16.3.2. Environmental Interventions

Environmental interventions seek to reduce or eliminate the availability of alcohol or to directly deter, through environmental means, specific alcohol-related behaviors such as impaired driving.

16.3.2.1. Reducing Availability

In Barrow, Alaska, during a 33-month period, a citizen referendum imposed a total ban on alcohol sales, then withdrew it, then reimposed it. There were significant decreases in emergency room visits for assaults when alcohol was banned and increases in assaults when the ban was lifted (Chiu, Perez, & Parker, 1997). Other research also shows that reducing alcohol use and availability is linked to reductions in violent behavior (Parker, 2004). Primarily, alcohol consumption and alcohol-related problems can be affected by restricting the hours and days when alcohol can be purchased and by reducing the number and types of alcohol outlets (Room et al., 2005). Moreover, alcohol server's liability for damage seems effective for reducing both rates of traffic fatalities and homicides (Room et al., 2005).

16.3.2.2. Legal Minimum Drinking Age and Zero Tolerance

The increase in the age of legal sales of alcohol has been the most successful intervention to date in reducing drinking and alcohol-related crashes among people under age 21 years (Shults et al., 2001; Wagenaar & Toomey, 2002). NHTSA (2005) estimates that a legal drinking age of 21 saves 700–1,000 lives annually and that more than 22,000 traffic deaths have been prevented by such laws since 1976. Approximately half the people who die in crashes involving drinking drivers under age 21 years are not the drinking driver, and more than one third of them are older than age 21 (NHTSA, 2005). Raising the drinking age to 21 also saves other people's lives. One national study indicated that individuals who grew up in states with a drinking age of 21 not only drank less when they were 21 but also drank less at ages 21–25 years (O'Malley & Wagenaar, 1991). A large review of empirical studies that examined the effects of the minimum drinking age law on fighting, assaults, and injury deaths (including drowning, homicides, and suicides) concluded that although there is some evidence that higher legal drinking ages reduce rates of other health and social problems, results are not as consistent as they are for traffic crashes (Wagenaar & Toomey, 2002).

Zero-tolerance laws, which make it illegal for people under 21 years old to drive after any drinking, have also contributed to declines in driving after drinking and alcohol-related traffic deaths among people younger than 21 (Shults et al., 2001; Voas, Tippetts, & Fell 2003; Wagenaar, O'Malley, & LaFond, 2001). Stepped-up enforcement of alcohol purchase laws aimed at sellers and buyers can reduce sales and consumption by underage drinkers (Bonnie & O'Connell, 2003; Wagenaar et al., 2000).

16.3.2.3. Price of Alcohol

Research clearly shows that increasing the price of alcoholic beverages reduces drinking, heavy drinking, and alcohol-related problems (Chaloupka, Grossman, & Saffer 2002). Price increases can also reduce violence and crime (Babor *et al.*, 2003). Cook and Moore (1993a, 1993b); Chaloupka, Shaffer, & Grossman (1993b); Markowitz and Grossman (2000); and Ruhm (1996) all found that raising taxes on alcohol reduces alcohol-related harm, including suicide, homicide, rape, robbery, assault, motor-vehicle theft, domestic violence, and child abuse. For example, a 10% increase in the tax on beer could reduce the probability of any child abuse by 1.2% and of severe child abuse by 2.1%. (Markowitz & Grossman, 2000). Among moderate drinkers, a 1% price increase has been associated with a 1.19% decrease in consumption (Manning, Blumberg, & Moulton, 1995). Hollingworth *et al.* (2006) concluded that a 17% increase in the price of alcohol could reduce deaths from harmful drinking by 1,490.

16.3.2.4. Alcohol Outlet Density and Hours of Sale

Alcohol outlet density has been associated with higher levels of community violence (Parker, 2004), and reducing density may prevent alcohol-related problems. Grube and Stewart (2004) identified six prospective studies of changes in outlet density. Effect sizes were small and inconsistent. Likewise, findings from studies of reducing hours of alcohol sale have also been mixed (Grube & Stewart, 2004). Research in the United Kingdom found no significant changes in alcohol-related or assault hospital admissions as a result of restricting hours of sales. A temporary extension of sale hours in Australia was not associated with increases in maximum consumption (McLaughlin & Harrison-Stewart, 1992). However, Smith (1988) found a 12% increase in traffic injury crashes after pub closing hours were extended from 6 to 10 p.m., Monday through Saturday in Victoria, Australia.

16.3.2.5. Responsible Beverage Service and Dram Shop Laws

Alcohol purchase surveys indicate that 40–90% of outlets will sell alcohol to underage people. Responsible beverage service (RBS) requires all servers to be above age 21 years, to not sell alcohol to individuals who are underage, to check identification and verify age, to train managers to identify false credentials, and to monitor drinks consumed by patrons. Lang, Stockwell, Rydan, and Beel (1998) and Saltz and Stanghetta (1997) found little effect of RBS on car crashes. Others (Forster *et al.*, 1994; Grube, 1997) found that RSB can reduce car crashes. Shults *et al.* (2001) found that server training programs were effective in reducing car crashes if they involved face-to-face instruction and strong management support. Dram shop laws, which enable injured individuals to recover damages from the retailer who sold alcohol to the individual causing the injury, have been estimated to reduce traffic fatalities among underage drinkers by 3–4% (Chaloupka, Saffer, & Grossman, 1993a).

16.3.2.6. Keg Registration, Social Host Liability, and Alcohol Licensing

Cohen, Mason, and Scribner (2001) reported that keg registration (where each keg purchased can be traced back to its buyer) is negatively correlated with traffic fatal-

ity rates. Unfortunately, no other studies of this intervention have been reported (Grube & Stewart, 2004). Grube and Stewart (2004) were able to identify one study (Whetten-Goldstein, Sloan, Stout, & Liang, 2000) that found social host liability laws were associated with lower alcohol-related motor-vehicle crash deaths. This effect was found among adults but not minors. There is strong evidence that sales monopoly systems, such as state- or government-owned, -operated, and -controlled liquor outlets, can limit both alcohol consumption and related problems. Total consumption generally increases when government-owned outlets are replaced by privately owned ones (Howat, Sleet, Elder, & Maycock, 2004).

16.3.3. Laws to Deter Drinking and Driving

16.3.3.1. Administrative License Revocation

Enactment and enforcement of administrative license revocation (ALR) laws, allow police to immediately seize the drivers license of anyone operating a motor vehicle while above the legal blood alcohol limit. These laws, in place in 40 states, have been associated with 6–12% declines in alcohol-related traffic deaths, (Tippetts, Voas, Fell, & Nichols, 2005; Voas, Tippetts, & Taylor, 2000).

16.3.3.2. Blood Alcohol Concentration Limit

By 2004, all U.S. states had set the legal BAC limit for drivers to 0.08%. This legal limit has been repeatedly associated with significant declines in alcohol-related crashes and fatalities (Bernat, Dunsmuir & Wagenaar, 2004, Hingson, Heeren, & Winter, 2000; Shults et al., 2001, Tippetts et al., 2005, Voas et al., 2000).

16.3.3.3. Laws for Convicted DWI Offenders

In 1988, Maine lowered its legal BAC limit for people with prior convictions from 0.10% to 0.05%. This new limit resulted in a 25% reduction in the proportion of fatal crashes involving drivers with prior convictions (Hingson, Heeren, & Winter, 1998). Impounding vehicles or license plates of previously convicted DWI offenders (Voas, Tippetts, & Taylor, 1997, 1998), and mandated use of ignition interlocks (Beck, Rooch, & Baker, 1999) have also reduced recidivism.

16.3.4. Enforcement and Education

Passage of a law does not by itself ensure reduction in injuries or deaths (Shaw & Ogolla, 2006). The extent to which these laws are enforced will influence their effect. The process of informing the public about new laws, their rationale, and that laws will be enforced is critical to success (Howat et al., 2004).

16.3.4.1. Sobriety Checkpoints

Sobriety checkpoints are a highly effective enforcement intervention (Elder et al., 2002; Shults et al., 2001) and have yielded declines of 18%–24% in alcohol-related fatal crashes (Fell, Lacey, & Voas, 2004). Checkpoints conducted by as few as 3–5 officers can be just as effective as checkpoints conducted by 15 or more officers.

16.3.4.2. *Mass Media Campaigns*

Elder *et al.* (2004) found a median decrease in injury crashes of 10% in their systematic review of the effectiveness of some mass media educational campaigns. The effects were similar for messages focused on legal consequences and on health consequences. They concluded that carefully planned, well-executed media campaigns, that attain adequate audience exposure and are implemented in conjunction with other ongoing prevention activities are effective in reducing alcohol-impaired driving and alcohol-related crashes. Additional support for media effects comes from a study demonstrating alcohol advertising has a direct link to alcohol consumption among underage drinkers (Snyder, Milici, Slater, Sun, & Strizhakova, 2006).

16.3.5. **Comprehensive Community Programs**

Several carefully conducted community-based initiatives have had particular success in reducing drinking and/or related alcohol problems among young people (Hingson & Howland 2002). Often multiple intervention strategies are incorporated into the programs, including school-based programs involving students, peer leaders, and parents; media advocacy; community organizing and mobilization; environmental policy change to reduce alcohol availability to youth; and heightened enforcement of laws regulating sales and distribution of alcohol and laws reducing alcohol-related traffic injuries and deaths.

Comprehensive community programs that have shown significant reductions in alcohol problems include Communities Mobilizing for Change Program (Wagenaar *et al.*, 2000), Community Trials Program (Holder *et al.*, 2000), Saving Lives Program (Hingson *et al.*, 1996), Matter of Degree Program (Weitzman, Nelon, Lee, & Wechsler, 2004), Fighting Back Program (Hingson *et al.*, 2005a) and a college community intervention (Clapp *et al.*, 2005). Compared to controls, the Communities Mobilizing for Change communities noted the following changes: 17% more alcohol outlets checked the age identification of youthful-looking customers, sales by bars and restaurants to potential underage purchasers decreased by 24%, the proportion of 18- to 20- year-olds seeking to buy alcohol decreased by 25%, the proportion of older teens who provided alcohol to younger teens decreased by 17%, and the number of underage respondents who drank alcohol in the past 30 days decreased by 7%. (Wagenaar *et al.*, 2000)

In the Saving Lives program (Hingson *et al.*, 1996), the proportion of drivers younger than 20 years who reported driving after drinking declined from 19% to 9% in 5 years. Fatal crashes declined 25%, and alcohol-related crashes declined 42% relative to the rest of Massachusetts.

In the Community Trials program, nighttime injury crashes declined by 10%, crashes in which the driver had been drinking declined by 6%, and assault injuries observed in emergency departments declined by 43% (Holder *et al.*, 2000).

The Matter of Degree Program, a college and community partnership showed significant reductions in heavy and frequent drinking, driving after drinking, alcohol-related injury, and other alcohol-related problems (Weitzman *et al.*, 2004). Significant reductions were also observed in the proportion of students who reported being assaulted by another drinking college student.

The Fighting Back program, in which five communities augmented environmental interventions to reduce alcohol availability with increased substance abuse treatment, found a 22% decline in alcohol-related fatal crashes at 0.01% BAC or

higher, a 20% decline at 0.08% BAC or higher, and a 17% decline at 0.15% BAC or higher during a 10-year period (Hingson et al., 2005b). A recent systematic review of community-based programs to reduce alcohol-impaired driving found positive results on a number of outcome measures. (Elder, Shults, Sleet, Compton, & Nichols, in press)

16.4. CONCLUSION

Research has identified a variety of strategies that can prevent alcohol-related injuries and deaths either by reducing individuals' level of alcohol consumption or by restricting people who have been drinking from engaging in behaviors that may pose a risk to themselves or others (e.g., driving a car).

By far, the most extensive literature on reducing alcohol-related injuries is in the arena of reducing motor-vehicle deaths. The interventions that have produced the greatest decline in alcohol-related traffic deaths are raising the legal drinking age to 21 years and general and specific deterrence laws (e.g., criminal per se laws, ALR, lowering of legal blood alcohol limits for adult drivers, zero-tolerance laws for underage drivers, and mandatory screening and treatment for drivers convicted of driving while intoxicated).

The progress made over the last two decades in reducing alcohol-related traffic crash deaths is attributable in part to the high and consistent level of testing for alcohol in drivers fatally injured in crashes. This has facilitated the evaluation of interventions designed to reduce alcohol-related traffic deaths. Unfortunately, alcohol testing of people who die from other injury deaths (e.g., falls, drownings, burns, poisonings, homicides, and suicides) has not been as comprehensive or consistent. Consequently, it is much more difficult to monitor the effect of interventions that seek to reduce other types of injury deaths. However, the implementation of the new National Violent Death Reporting System (NVDRS) by the CDC will facilitate the study of alcohol involvement in violent deaths. The NVDRS is a population-based system that collects information about violent deaths related to suicide, homicides, undetermined intent, legal intervention, and unintentional firearm injury (Paulozzi, Mercy, Frazier, & Annett, 2004). In addition, to improve surveillance of alcohol-related injury, every unnatural death in the United States should be tested for alcohol. The average cost of such testing would be approximately \$50 per deceased person or an annual cost of \$7.2 million, if all people who die from injuries annually (about 140,000) were tested for alcohol impairment.

Despite the lack of comprehensive alcohol testing of people who die from homicide, suicide, and unintentional injuries, the research literature indicates that individually oriented treatment and brief intervention counseling can reduce alcohol-related traffic deaths, suicide attempts, domestic violence, and other unintentional injuries. Screening and brief counseling for alcohol problems is also effective in reducing heavy alcohol use (Babor et al., 2003) and has been shown to be cost effective among trauma patients (Gentilello et al., 2005). Likewise, environmental interventions have been associated with reduction in alcohol-related injuries. In particular, increasing the price of alcohol has been associated with reductions in alcohol-related traffic deaths, suicides, homicides, domestic violence, child abuse, rapes, robberies, and assaults. Moreover, raising the legal drinking age has reduced alcohol-related traffic deaths, suicide, fighting, and assault.

There are several promising areas for future research. In particular, additional efforts to further delay the initiation of alcohol use among minors are warranted

and can build on current knowledge showing that the earlier youth begin to drink, the more likely they will experience unintentional injuries, motor-vehicle crashes, and physical fights after drinking both as adolescents and as adults (Hingson, Heeren, Jamanka & Howland, 2000; Hingson, Heeren, Zakocs, 2001; Hingson, Heeren, Levenson, Jamanka & Voas, 2002). Moreover, cross-cutting efforts that seek to reduce and measure a range of alcohol-related injuries are warranted. Rather than focusing on one type of injury, intervention efforts should examine multiple outcomes. In addition, there is a need to examine the potential role of the use of other substances and injuries. This chapter focused exclusively on alcohol use and injuries. Many alcohol consumers also use other substances, often concurrently with their alcohol use, which can potentially increase their risk for injury. However, little information is available about the injury risk among those who use multiple substances or about appropriate prevention strategies.

Research in trauma centers and emergency departments indicates screening and brief interventions in those settings can reduce alcohol-related problems. According to the Alcoholism Alcohol Policy Information System, there are laws currently in place in 28 states and the District of Columbia (NIAAA, 2005) that allow insurance companies to deny medical reimbursement for treatment of people who have been injured under the influence of alcohol or impairing drugs. Clearly, these laws serve as disincentives for diagnosing alcohol problems in these settings. Whether repeal of those insurance laws will result in more emergency department patients being screened and offered alcohol counseling and whether that, in turn, will reduce alcohol-related injuries and deaths at the population level warrant research attention.

Grassroots organizations such as MADD have played a pivotal role in stimulating passage of laws to reduce injuries related to alcohol. But, as this chapter indicates, both education and enforcement are needed for these laws to succeed. A growing number of evaluations of comprehensive community interventions indicate that education, reducing alcohol availability, and enforcement of alcohol-control and drinking and driving laws (particularly using sobriety check points at the community level) can further reduce alcohol-related traffic injuries and death. Ecological and health promotion approaches that focus on using multidisciplinary and multisector strategies are also needed (Hingson & Sleet, 2006). These programs may also have the potential to reduce nontraffic alcohol-related injuries. A key question is how to mobilize actions at the community level to motivate policy makers, city planners, and advocacy groups to work together to reduce all injuries related to alcohol.

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