New Research Findings Since the 2007 *Surgeon General's Call to Action to Prevent and Reduce Underage Drinking*: A Review

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ABSTRACT. Objective: In 2007, the U.S. Department of Health and Human Services issued *The Surgeon General's Call To Action To Prevent And Reduce Underage Drinking*, a publication documenting a problem linked to nearly 5,000 injury deaths annually and poor academic performance, potential cognitive deficits, risky sexual behavior, physical and sexual assaults, and other substance use. This report reviews subsequent underage drinking and related traffic fatality trends and research on determinants, consequences, and prevention interventions. **Method:** New research reports, meta-analyses, and systematic literature reviews were examined. **Results:** Since the *Call to Action*, reductions in underage frequency of drinking, heavy drinking occasions, and alcohol-related traffic deaths that began in the 1980s when the drinking age nationally became 21 have continued. Knowledge regarding determinants and consequences, particularly the effects of early-onset drinking, parental alcohol provision, and cognitive effects, has expanded. Additional studies

support associations between the legal drinking age of 21, zero tolerance laws, higher alcohol prices, and reduced drinking and related problems. New research suggests that use/lose laws, social host liability, internal possession laws, graduated licensing, and night driving restrictions reduce traffic deaths involving underage drinking drivers. Additional studies support the positive effects of individually oriented interventions, especially screening and brief motivational interventions, web and face-to-face social norms interventions, college web-based interventions, parental interventions, and multicomponent community interventions. **Conclusions:** Despite reductions in underage alcohol consumption and related traffic deaths, underage drinking remains an enduring problem. Continued research is warranted in minimally studied areas, such as prospective studies of alcohol and brain development, policy studies of use/lose laws, internal possession laws, social host liability, and parent–family interventions. (*J. Stud. Alcohol Drugs*, 75, 158–169, 2014)

IN 2007, THE U.S. Department of Health and Human Services issued *The Surgeon General's Call to Action to Prevent and Reduce Underage Drinking*, a publication documenting a problem contributing to nearly 5,000 injury deaths annually, including the three leading causes under age 21—traffic deaths, suicides, and homicides (U.S. Department of Health and Human Services, 2007). It also contributes to risky sexual behavior, physical and sexual assaults, various nonfatal injuries, poor academic performance, and second-hand effects to others. The *Call to Action* was the second surgeon general's report on alcohol, relative to 30 regarding tobacco.

This article explores trends in underage drinking and related traffic fatalities since the *Call to Action* and new research regarding determinants, consequences, and interventions to address underage drinking and related harms.

Trends: Underage drinking and related traffic fatalities

The *Call to Action* identified alcohol as the substance most widely abused by American youths. This remains the

case. Youths drink less frequently than adults but consume more when they drink. Underage drinkers average six drinks per occasion five times a month. In 2008–2009, 12% of underage drinkers had nine or more drinks on their last occasion (Substance Abuse and Mental Health Services Administration [SAMHSA], 2011). The Monitoring the Future survey indicated, in 2011, that 13%, 27%, and 40% of 8th-, 10th-, and 12th-grade students nationwide, respectively, reported drinking in the past 30 days, and 6%, 15%, and 22%, respectively, reported heavy drinking occasions (five or more drinks) in the past 2 weeks (Johnston et al., 2013).

In 1984, when only 22 states had a minimum legal drinking age of 21, Congress passed legislation to withhold highway construction funding from states without that law. By 1988, all states adopted the law. According to Monitoring the Future, in 1975, 68% of 12th graders drank in the last 30 days and 37% had heavy drinking occasions in the past 2 weeks. By 1982, those percentages rose to 70% and 41%. Subsequently, they declined to 40% and 22% in 2010, proportional declines of 43% for drinking and 46% for heavy drinking (Figure 1).

The National Highway Traffic Safety Administration (NHTSA) reported that, in 1982, 5,244 (66%) of traffic deaths among persons ages 16–20 years were alcohol related. By 2010, that figure had dropped to 1,262 (37%). The proportional decline of alcohol-related traffic deaths among 16- to 20-year-olds (77%) exceeded that for all ages (62%),

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FIGURE 1. Alcohol: Trends in 2-week prevalence of five or more drinks in a row among college students versus others 1-4 years beyond high school, 1982-2010. HS = high school. Adapted from Monitoring the Future data (Johnston et al., 2013). Inset photo: President Ronald W. Reagan signs the national minimum legal drinking age bill into effect at the White House Rose Garden, July 17, 1984 (source: Mothers Against Drunk Driving; reprinted with permission). Book cover image: *The Surgeon General's Call to Action to Prevent and Reduce Underage Drinking 2007* (source: U.S. Department of Health and Human Services; reprinted with permission).

but the 16- to 20-year-old rate still remained higher (Figure 2). Of note, declines in the rate of traffic deaths related to alcohol exceeded nonalcohol declines in each age group.

The NHTSA (2013a) estimates that the minimum legal drinking age of 21 has prevented 28,765 traffic deaths since 1975 (3,258 since the *Call to Action*).

Social determinants

Home environment/parents. Home environment matters. The younger the drinker, the more likely alcohol was obtained at home from parents, other adults, siblings, or liquor cabinets (SAMHSA, 2011).

Parents who have heavy drinking occasions are twice as likely as abstainers to have children with heavy drinking occasions (20% vs. 10%) and who meet alcohol dependence criteria (10% vs. 5%) (SAMHSA, 2008). Youths whose parents permit drinking at home are more likely to drink excessively and develop related problems (Komro et al., 2007; Livingston et al., 2010; McMorris et al., 2011; van den Eijnden et al., 2011).

Peers. The *Call to Action* (2007) recognized that peers influence underage drinking. Peers have an influence through modeling, encouragement, misperceptions of how much other adolescents drink, affiliations with drinking friends, and by positive media messages about adolescent

FIGURE 2. Alcohol- versus non-alcohol-related traffic fatalities, rate per 100,000, ages 16–20 versus all ages, United States, 1982–2010. Adapted from U.S. Fatality Analysis Reporting System (National Highway Traffic Safety Administration, 2013b) and U.S. Census Bureau (2013). Book cover image: *The Surgeon General's Call to Action to Prevent and Reduce Underage Drinking 2007* (source: U.S. Department of Health and Human Services; reprinted with permission).

drinking (Brown et al., 2008). Peer influences are thought to peak around ages 11–13 years (Windle et al., 2008). As peer social interactions have expanded online, researchers have begun to assess virtual peer influences on alcohol use. Teunissen et al. (2012) examined the influence of pro- and anti-alcohol messages delivered by confederate peers to 14- to 15-year-olds in an Internet chat room. When delivered by peers identified as popular, subjects' willingness to drink changed accordingly. Similarly, Litt and Stock (2011) reported that adolescents ages 13–15 reported greater willingness to drink alcohol after viewing experimenter-generated Facebook pages portraying alcohol use as normative among older peers.

Legal drinking age. Some have argued that the legal drinking age of 21 drives underage drinking underground into areas lacking adult supervision, prompting extreme amounts of consumption. The National Epidemiologic Survey of Alcoholism and Related Conditions, conducted by the National Institute on Alcohol Abuse and Alcoholism in 2001–2002 ($N = 43,093$), asked the maximum number of drinks respondents consumed on an occasion the previous year. Underage persons were less likely to consume extreme amounts of alcohol than legally drinking young adults. Less than 10% of 18- to 20-year-olds, compared with 15% of

those ages 21–24, consumed 20 or more drinks on their heaviest drinking day, the equivalent of a fifth of distilled spirits, a very dangerous amount (Hingson and White, 2012).

Some believe that European youths with lower drinking ages than those in the United States are less likely to engage in hazardous drinking. However, a World Health Organization (WHO) study (2012) of 15-year-olds in 36 European countries and Canada found that, relative to the United States, in all but four countries a greater percentage drank in the past month and, in all but one, a greater percentage were drunk at least twice in the past year.

Prospective studies need to determine if drinking-age increases in Europe will reduce drinking in targeted age groups, as well as younger adolescents and adults. Compared with the rest of the world, Europe has the highest per capita alcohol consumption (11.9 vs. 6.2 liters of pure alcohol), deaths attributable to alcohol (6.5% vs. 3.2%), alcohol-attributable burden of disease measured in disability-adjusted life years (11.6% vs. 4%), and past-year prevalence of alcohol use disorders (5.5% in Western Europe, 10.9% in Eastern Europe vs. 3.6% worldwide) (Rehm et al., 2009).

Advertising, media, and promotion. New prospective studies report associations between exposure to alcohol in advertising, media, and brand promotions and youth drink-

ing. Smith and Foxcroft (2009) reviewed prospective cohort studies involving more than 13,000 people ages 10–26 years. Baseline nondrinkers reporting greater exposure to advertisements were more likely to become drinkers at follow-up. Discussing whether these associations reflect causality, the authors noted (a) the need to control potential confounds such as alcohol expectancies, family history, peer influence and personality characteristics; (b) substantial attrition in some studies; and (c) possible publication bias.

Anderson et al. (2009) reviewed 13 longitudinal studies, including 7 that Smith and Foxcroft (2009) reviewed, recruiting 38,000 adolescents between the ages of 10 and 21 years at baseline. Twelve studies linked exposure to alcohol marketing and promotions and movie/television portrayals with levels of alcohol use during 8-month to 8-year follow-up periods. These authors also identified potential confounders and possible publication bias as limitations and noted that advertising exposure measures varied across studies. Also, in some European studies, adolescents could legally drink during the study period.

Alcohol-branded merchandise ownership by 10- to 14-year-old subjects has also been associated with drinking initiation, heavy drinking occasions at the 8-month follow-up, and drinking among adolescent girls (Fisher et al., 2007; McClure et al., 2009). Whether associations exist between youth drinking and exposure to alcohol advertisements and product placement on websites and in social media remains unclear. Nor are mechanisms known by which such exposures might influence youth drinking.

Underage drinking consequences

Fatal crash risk. Voas et al. (2012) updated national risk estimates of drinking drivers being fatally injured relative to sober drivers. At each blood alcohol concentration (BAC) examined from .01% to .15% or greater, odds of 16- to 20-year-old drivers being killed in a single-vehicle crash compared with same-age sober drivers increased significantly. The odds at each BAC were higher for 16- to 20-year-olds than those ages 21–34 years and 35 years or older. Odds of a 16- to 20-year-old driver being killed relative to a same-age sober driver were 1.5 at BAC .01%–.019%, 3.8 at .020%–.049%, 12.2 at .05%–.079%, 31.9 at .08%–.099%, 122.4 at .100%–.149%, and 4,728 at .15% or greater.

Early drinking onset. The *Call to Action* indicated that persons who begin drinking before age 15 are more likely than those who start at 21 years or older to ever experience alcohol dependence (40% vs. 10%). National cross-sectional surveys, longitudinal research, and international studies have reported this association, often controlling for respondent age, gender, education, race/ethnicity, and family history of alcohol dependence. Subsequent research confirmed the association controlling for genetics by studying monozy-

gotic and dizygotic twins discordant on age at first drinking (Agrawal et al., 2009; Grant et al., 2006).

Early drinking onset also has been linked to the development of dependence at earlier ages and chronic-relapsing dependence characterized by more episodes of longer duration and meeting more dependence diagnostic criteria (Guttmannova et al., 2011; Hingson et al., 2006).

The *Call to Action* also associated early drinking onset with risky sexual behavior, car crash involvement, unintentional injuries, and physical fights after drinking in both adolescence and adulthood. Subsequent research linked early drinking to suicidal behavior, dating violence victimization and perpetration (Swahn et al., 2008); prescription drug misuse (Hermos et al., 2009); injuring oneself and others after drinking as adults (Hingson and Zha, 2009a); and younger drug use onset, drug abuse, and dependence, which predict driving and motor vehicle crash involvement after drug use (Hingson et al., 2008; Hingson and Zha, 2009b).

The *Call to Action* indicated that 92% of alcohol consumed by 12- to 14-year-olds is on heavy drinking occasions, defined as adults drinking four (women) or five (men) or more drinks on an empty stomach over a 2-hour period, typically reaching a BAC of .08% or more, the legal level of intoxication for adults. Subsequent research indicates that young adolescents reach BACs of .08% or more after fewer drinks (Donovan, 2009).

Adolescent neurocognitive development. The *Call to Action* raised particular concerns about the susceptibility of developing adolescent brains to long-term negative alcohol effects. Subsequently, Squeglia et al. (2009a, 2009b) examined neurocognition in adolescents ages 12–14 years before heavy drinking onset and 3 years later after some subjects initiated heavier alcohol use. During the year before follow-up among females, more drinking days and drinks per month predicted visuospatial memory deficits, and among males, greater hangover symptoms predicted attention impairments. Hanson et al. (2011) observed similar outcomes. In contrast, Norman et al. (2011) observed that some brain abnormalities can be identified in adolescents with limited drinking histories who later become heavy drinkers.

Overdoses. Between 2001 and 2005 annually, 252 persons younger than age 21 died from overdoses attributable to alcohol alone or combined with other drugs (Centers for Disease Control and Prevention, 2013). Examination of the Nationwide Inpatient Sample, representative of U.S. community hospitals, revealed that, in 2008, 31% (35,384) of overdose hospitalizations among people ages 12–20 involved alcohol, 14,967 involved alcohol only, and 20,417 involved alcohol and drugs combined. From 1999 to 2008, the overdose hospitalization rate involving alcohol increased only 6%, drugs only 19%, but alcohol and drugs combined 41% (White et al., 2011).

Economic costs. Harmful alcohol use cost the United States \$224 billion in 2006 (\$746 per person). Local, state,

and federal governments and persons other than the drinkers bear more than half the costs. Eleven percent (\$24.6 billion) resulted from underage drinking (\$90 per person) (Bouchery et al., 2011).

A Nationwide Inpatient Sample analysis identified 39,619 hospitalizations among 15- to 20-year-olds in 2008 where alcohol dependence, abuse, or alcohol-related mental health disorder was involved, resulting in charges of \$755 million dollars (Kim et al., 2012).

Prevention

Several types of interventions can prevent underage drinking and its consequences: policy, individually oriented, school-based, parental, computer, and multicomponent community interventions.

Policy interventions

Legal drinking age. An evaluation of 1975–1993 data from the U.S. Fatality Analysis Reporting System (NHTSA, 2013b), annual surveys titled Monitoring the Future (Johnston et al., 2013), and Vital Statistics (e.g., Murphy et al., 2013), associated lowering the drinking age among 18- to 20-year-olds with the following:

- a 17% increase in night fatal crashes, those most likely to involve alcohol, the greatest of any age group, and
- a 10% increase in suicides, past-month drinking, and heavy episodic (“binge”) drinking (Carpenter and Dobkin, 2011).

In contrast, Fell et al. (2009), examining 1982–2004 data controlling for numerous potential confounding factors and laws, linked the 21-year-old drinking-age adoption with a 16% decline in the ratio of drinking to nondrinking drivers under 21 years of age in fatal crashes, replicating previous research (Shults et al., 2001). Zero tolerance laws, making it illegal for persons under 21 to drive after any drinking, and underage alcohol use/lose laws were each associated with independent 5% declines. Of note, traffic laws targeting adults—such as .08% BAC laws, administrative license revocation, and seat belt laws—were also independently associated with 8%, 5%, and 3% alcohol-related fatal crash declines, respectively, involving 18- to 20-year-old drivers (Fell et al., 2009). These laws may signal to youth wide-ranging social concern about alcohol misuse problems.

McCartt et al. (2010) examined national alcohol-related fatal crash data before and after numerous states raised the drinking age. In 1982, 61% of drivers ages 16–20 years had positive BACs compared with 33% in 2008, a 46% decline, 54% specifically among 16- and 17-year-olds. Declines were smaller, at 17% and 29%, respectively, for drivers ages 21–24 years and 25 years and older, who were not targeted by the laws.

An analysis of two national surveys 10 years apart, controlling for numerous confounding variables, found that respondents raised in states where drinking was legal before age 21 were significantly more likely as adults to meet alcohol and other drug abuse and dependence criteria (Norberg et al., 2009).

Graduated driver licensing with night driving restrictions and use/lose laws. The *Call to Action* recommended enforcement of graduated driving license laws requiring nighttime driving restrictions, that novice drivers to be accompanied by an adult parent or guardian, and restrictions on the number of other teenage passengers. Fell et al. (2011), examining 1990–2008 fatal crash data, found that nighttime restrictions reduced the number of drinking drivers ages 16–17 in nighttime fatal crashes by 13%.

Use/lose laws allow driver's license suspension for underage alcohol violations. Cavazos-Rehg et al. (2012) examined the Youth Risk Behavior Surveillance System (YRBSS) survey data by state from 1999 to 2009. Controlling for gender, race/ethnicity, and age, students in states with the strongest use/lose and graduated driver licensing laws versus the weakest rated by the Insurance Institute for Highway Safety (2011) were half as likely to report driving after drinking.

Internal possession laws. In 12 states, underage persons can be cited for drinking if intoxication is observed or blood, breath, or urine tests positive for alcohol. Disney et al. (2013) analyzed YRBSS data from 1991 to 2009 ($N = 219,171$). Past-month drinking declined significantly among students ages 14 years or younger (15%) and 15 years (11%) but not among older adolescents. Heavy drinking occasions remained unchanged.

Social host liability. Social host liability laws hold adults accountable for providing alcohol to underage persons other than their own children. Dills (2010) examined national survey data from 1984 to 2004 and alcohol-related vs. non-alcohol-related fatal traffic accidents among those 18–20 years of age from 1975 to 2005. Controlling for drinking age, several drinking laws, and economic factors, social host liability laws were independently associated with declines in heavy episodic drinking (3%), driving after drinking (4%), and alcohol-related traffic deaths (5%–9%).

Price and tax. Consistent with other recent reviews (Elder et al., 2010; Wagenaar et al., 2009, 2010; Xu and Chaloupka, 2011), a WHO review (2009) stated, “When other factors are held constant, such as income and the price of other goods, a rise in alcohol prices leads to less alcohol consumption and less alcohol-related harm and vice versa” (p. 4). “Policies that increase alcohol prices delay the time when young people start to drink, slow their progression towards drinking large amounts, and reduce their heavy drinking and volume of alcohol drunk on an occasion” (p. 76). Similarly, Xu and Chaloupka (2011) wrote, “raising prices of alcoholic beverages not only postpones drinking initiation and dependence formation among adolescents and young adults but also re-

duces heavy or chronic alcohol use among adults,” (p. 240) and, “however, a direct demonstration that changes in alcohol prices cause changes in adverse consequences (rather than just being associated with them) still is lacking and should be the focus of future studies” (p. 242). Last, although very high prices for alcohol might stimulate illegal production, in the United States over the past 60 years, alcohol prices have not kept pace with inflation (Hingson, 2010).

Outlet density. Cross-sectional and prospective studies have linked higher alcohol outlet density with increased alcohol-related problems (Campbell et al., 2009; Reboussin et al., 2011; Scribner et al., 2008). Research needs to test the impact of reducing outlet density (Campbell et al., 2009).

Individually oriented interventions

The *Call to Action* reported early evidence of the effectiveness among adolescents of brief motivational interventions reducing drinking and related consequences. Subsequently, Larimer and Crouce (2007) observed reductions in drinking outcomes in 10 of 14 college student brief motivational intervention studies. Reviewing 36 studies evaluating 56 interventions published between 2007 and 2010, Crouce and Larimer (2011) identified consistent support for the efficacy of brief individual motivational interventions with personalized feedback or personalized normative feedback.

Carey et al. (2007) reviewed 62 randomized controlled studies of individual-level interventions to reduce college student drinking between 1985 and 2007. Intervention participants reduced their quantity and frequency of heavy drinking and alcohol-related problems at 4–195 weeks after intervention.

Tripodi et al. (2010) reviewed 16 experimental studies testing individually oriented approaches to reduce drinking frequency and quantity and alcohol-related problems among 12- to 19-year-olds. All tested interventions yielded reductions, with the greatest effects found for brief motivational interventions with aftercare for adolescents and parents, adolescents only, and multidimensional family therapy.

Jensen et al. (2011) reviewed 21 motivational counseling intervention studies and 13 brief intervention studies. Alcohol and other drug use were significantly reduced for more than 6 months after the interventions.

Yuma-Guerrero et al. (2012) reviewed seven randomized controlled trials evaluating brief drinking interventions in adolescent acute care settings. Four found significant intervention efficacy, but no single intervention reduced both alcohol consumption and related consequences. Experimental screening and brief motivational intervention studies for alcohol misuse at six different university health services found significant reductions in drinking up to 6 months after intervention and in alcohol-related problems up to 9 months

after intervention (Fleming et al., 2010; Schaus et al., 2009). Seigers and Carey (2010) reported that six of eight experimental and four uncontrolled studies at university health centers observed reductions in alcohol consumption at follow-ups from 1 month up to 1 year. Because most college students visit health services annually, universal screening there could yield population-level health effects.

A meta-analysis of 18 randomized controlled trials of the Brief Alcohol Screening and Intervention of College Students (BASICS) reported that intervention-exposed subjects averaged 1.5 fewer drinks per week and a 13% decline in alcohol problems relative to controls 12 months later (Fachini et al., 2012).

The American Academy of Pediatrics recommends routine screening and counseling for underage drinkers. However, a national survey in 2006 found 62% of 18- to 20-year-olds saw a physician in the past year, but of them only 25% were asked about drinking, 12% were advised about health risks, and 5% were advised to reduce or stop drinking (Hingson et al., 2012). A subsequent national survey of 10th graders with an average age of 16 years found that 82% saw a doctor the previous year. Of them, 54% were asked about drinking and 40% were advised about related harms. However, only 17% were advised to reduce or stop drinking. Among respondents drunk six or more times in the past month, only 25% were advised to reduce or stop drinking (Hingson et al., 2013).

Normative reeducation interventions

College students often overestimate fellow students' alcohol consumption and may drink more to conform to misperceived group norms. Moreira et al. (2009) reviewed 23 randomized trials testing whether informing college students of their campus's true consumption norms reduced drinking. Web/computer feedback programs yielded significant reductions of up to 16 months in alcohol problems, peak BACs, frequency and quantity of drinking, and heavy drinking occasions. Individual face-to-face feedback produced declines in frequency of drinking at the 6-month follow-up and related problems at the 17-month follow-up. Group feedback reduced drinking quantity and heavy drinking occasions for only 3 months. Mailed feedback produced no effects. Campus-wide, social marketing study results were inconsistent.

Age-appropriate interventions

Recognizing that different interventions may be more developmentally appropriate and effective at different ages, Spoth et al. (2008) reviewed more than 400 interventions targeting underage drinking. Table 1 lists the interventions providing the most promising evidence for persons younger than age 10 years, 10–15 years, and 16–20 years or older.

TABLE 1. Interventions aimed at different age groups of adolescents with most promising level of evidence of effect

Age group, in years		
<10	10–15	16 to >20
Linking the interests of Families and Teachers	Keepin' It REAL	Project Toward No Drug Abuse
Raising Healthy Children	Midwestern Prevention Project/Project STAR	Yale Work and Family Stress Program
Seattle Social Development Project	Project Northland	Mississippi Alcohol Safety Education Program and Added Brief Individual Intervention
Nurse-Family Partnership Program	Strengthening Families Program: For Parents and Youth 10–14	
Preventive Treatment Program (Montreal)		

Note: Adapted from Spoth et al. (2008).

School-based prevention

Foxcroft and Tsertsvadze (2012) reviewed 53 experimental studies examining school-based universal youth alcohol misuse prevention programs. Eleven studies focused solely on preventing alcohol misuse. Six reported statistically significant reductions compared with controls. Thirty-nine trials evaluated generic interventions targeting alcohol, tobacco, other drugs, and antisocial behavior. Fourteen demonstrated significantly greater reductions on alcohol use measures than did the standard curriculum. Postintervention beneficial impacts ranged from 0 days to 10 years.

Impact duration tended to be longer for generic versus alcohol-specific programs. Generic programs based on psychosocial theory or developmental approaches, such as the Life Skills Training Program in the United States (Botvin et al., 1984, 1995, and 2001), the Unplugged Program in Europe (Faggiano et al., 2007), and development of behavior norms and peer affiliation through the Good Behavior Game (Kellam et al., 2008) were more likely to report modest positive significant drunkenness and heavy drinking occasion reductions lasting several years. Further, 12 of 20 multicomponent intervention trials (school-based with community or family components) had significant benefits on alcohol measures ranging from 3 months to 3 years.

Community interventions for young adolescents

Hawkins et al. (2009) compared the Communities That Care intervention in 13 communities with 13 communities matched for state, population size, race/ethnicity, and economic conditions. Coalition members were trained to use pre-program surveys to prioritize risk factors and implement evidence-based interventions targeting youths ages 10–14 years (Grades 5–9). By grade 8, intervention students were less likely to initiate alcohol use (60%) and delinquent behavior (41%). At grades 8 and 10, intervention students had significantly lower alcohol use, heavy drinking episodes, smokeless tobacco use, and delinquent behavior.

Parental initiatives

Pre-college. Smit et al. (2008) reviewed 18 family intervention randomized trials to reduce adolescent drinking. Seven reported lower intervention group alcohol initiation and five significant reductions in past-month or past-year alcohol use. This meta-analysis found consistently favorable effects on delaying alcohol initiation and frequency of alcohol use. Foxcroft and Tsertsvadze (2012) reviewed 12 family intervention studies. Nine identified significant short- and long-term alcohol misuse reductions among youths.

Spoth et al. (2009) randomly assigned sixth graders and their parents in 33 schools to the Iowa Strengthening Families Program (ISFP), the Preparing for the Drug Free Years (PDFY), and a control group. The ISFP sought to improve parent-child relations, strengthen communication, and increase child coping skills through a seven-session, 13-hour, in-school intervention. The PDFY offered five weekly 2-hour sessions to enhance parent-child interaction and reduce children's substance initiation. When reinterviewed as high school seniors, one third fewer ISFP-exposed versus control students reported drunkenness. At age 21, they reported significantly fewer episodes of drunkenness, alcohol problems, cigarette use, and illicit drug use. The PDFY and control group senior differences were smaller and not significant at age 21.

College initiatives. Parental influence can extend into college. Ichiyama et al. (2009) tested sending parents a handbook for talking with college students about alcohol. Comparison parents received brochures detailing university alcohol policies and penalties. Students who did not drink before college and whose parents reviewed the handbook were less likely to start drinking. Females already drinking were less likely to experience freshman-year drinking increases. Parental intervention, combined with a brief motivational intervention, produced lower drinking levels and high-risk drinking among college students versus controls (Turrissi et al., 2009). Parental interventions administered before, not after, matriculation produced significant transi-

tion out of heavy drinking lasting through the 15-month follow-up (Turrissi et al., 2013).

Computer interventions

Carey et al. (2009), reviewing 25 studies of 43 separate interventions for college students, found short-term (<5 months) reductions in the amount consumed on drinking days and the maximum quantity consumed. Long-term (>6 months) differences in heavy drinking frequency were not observed, but reductions in drinking frequency, quantity, and alcohol-related problems were reported.

Campus-wide Internet interventions

AlcoholEdu, a web-based intervention addressing alcohol misuse that is required for freshmen in more than 500 colleges and universities, includes personalized feedback to change normative beliefs about alcohol use, education about alcohol's effects on the brain and behavior, risk awareness, challenges to expectations about alcohol effects, suggestions for alcohol-free activities, and alcohol harm minimization strategies (e.g., avoiding drinking games) (Outside The Classroom, 2013). Paschall et al. (2011a, 2011b) randomized 32 colleges in the fall of 2007 and 2008 to AlcoholEdu or a control condition. None had previously implemented an online course. The 2- to 3-hour course had one pre-matriculation late summer session and another 30–45 days later. Students completed online surveys about their drinking during each session and in the spring.

Reductions in 30-day alcohol use, heavy drinking episodes, and alcohol problems—including psychological problems, hangovers, nausea, vomiting, blackouts, social problems, trouble with police, and crime or sexual assault victimizations—were observed in the fall but not the spring semester. The authors recommended that future studies explore booster exposure and integration into multicomponent campus community interventions because program benefits were insufficient for it to stand alone.

College/community partnerships

After Marshall University and the city of Huntington, WV, collaborated on enhanced highly publicized enforcement of underage alcohol sales laws as well as drinking and driving laws, reductions were found in the proportions of underage alcohol purchase attempts resulting in sales and of 16- to 20-year-old drivers stopped at roadside surveys with elevated BACs. Little change was found in the comparison city of Morgantown, home of West Virginia University (McCartt et al., 2009).

A similar University of Rhode Island program increased student awareness of alcohol control measures and perceived likelihood of underage drinking apprehension. Reductions

were recorded in police-reported alcohol incidents but not in student-reported alcohol use or alcohol-impaired driving (Wood et al., 2009).

In North Carolina, 10 universities were randomized to intervention and comparison conditions. Intervention schools formed campus–community coalitions to reduce alcohol availability, address alcohol prices and marketing, improve social norms about alcohol, and reduce related harms. Social norms marketing campaigns, alcohol restrictions at campus events, and heightened enforcement of underage sales resulted in approximately 225 fewer severe alcohol-related consequences per month and 100 fewer injuries to others each year at each university (Wolfson et al., 2007, 2012).

Two Washington state universities' college–community partnerships heightened enforcement of underage alcohol sales laws and surveillance of off-campus student parties. Colleges offered alcohol-free late-night activities and convened neighborhood/college student forums about disruptive parties. Significant reductions in heavy drinking episodes were recorded relative to a comparison college (Saltz et al., 2009).

The Safer California University Project randomly assigned seven public universities to implement college/community coordinated nuisance party enforcement, heightened enforcement of laws regarding selling alcohol to minors, driving under the influence (DUI) checkpoints, and implementation of social host ordinances. Relative to seven comparison colleges, at each intervention college, annually 1,500 fewer students drank to intoxication and 10,000 fewer incidents of intoxication occurred (Saltz et al., 2010).

Military/community interventions

Spera et al. (2010) evaluated an Air Force/community program, "Enforcing Underage Drinking Laws." Interventions included shoulder taps and controlled party dispersal to reduce alcohol availability, compliance check surveys to prevent underage alcohol sales, increased community DUI checks, distinct underage driver's licenses, community awareness programs, and alcohol-free recreation activities. Alcohol problems among Air Force personnel ages 18–24 years decreased 6.6% in the Air Force overall but 9.8% and 13.6% in two Arizona demonstration communities, suggesting that multicomponent military/community interventions can reduce underage military alcohol problems.

Conclusion

Trends show important success of measures to control underage drinking, and recent research has identified new effective tools to further address this issue. These warrant expanded deployment. The need for continued emphasis on this problem stems from the magnitude of the problem

(despite achievements) and from knowledge that even more progress can be achieved.

Since *The Surgeon General's Call to Action to Prevent and Reduce Underage Drinking* in 2007, national surveys indicate that the percentages of 8th, 10th, and 12th graders who drink and have heavy drinking occasions have declined, continuing trends that began in the 1980s with the passage of the 21-year minimum drinking age nationwide. Alcohol-related traffic deaths have also declined among 16- to 20-year-olds, more than any other age group and more than same-age, non-alcohol-related traffic deaths.

Our knowledge regarding underage drinking's determinants and consequences has expanded. Previously reported associations between earlier drinking onset age and development of alcohol dependence have now been observed after controlling for genetics. Early drinking onset has also been linked to a wider array of negative health consequences. New research indicates that smaller, very young adolescents become intoxicated with fewer drinks than adults. Also, increases in blood alcohol concentrations raise the risk of fatal crashes more for underage than adult drivers. Initial prospective research shows that the adoption of heavy drinking can precede the development of chronic cognitive impairments in young adolescents and vice versa. Also, parents' drinking patterns and providing alcohol to adolescents can increase the adolescents' risk of developing heavier drinking patterns. Very high consumption levels on drinking occasions are most likely to occur after people reach the legal drinking age. In most European countries with lower legal drinking ages, a higher percentage of youths ages 15–16 years drink to intoxication than in the United States. New prospective research indicates that alcohol advertising and promotion and media portrayals are associated with underage drinking.

Expanding evidence indicates that a variety of interventions reduce underage drinking and related problems. Additional research supports associations between higher alcohol prices and lower consumption and related problems, benefits of the 21-year minimum legal drinking age, and zero tolerance laws making underage driving after any drinking illegal. New research suggests that use/lose laws, internal possession laws, social host liability, adult traffic safety legislation, graduated driver licensing, and night driving restrictions can reduce underage alcohol-related traffic deaths. Higher drinking ages have been linked to lower rates of alcohol and other drug use disorders in adults. Research supporting the effectiveness of individually oriented interventions, such as screening and brief motivational counseling intervention, expanded considerably. Family–parent initiatives in the middle-school years can have effects enduring to age 21, and parental interventions, even with college students, may hold promise. Web-based and face-to-face social norms interventions reduced drinking-related problems among college students. Community evidence-based intervention programs reduced drinking and related problems in early adolescence.

Campus-wide Internet educational interventions have produced short-term drinking and alcohol problem reductions in college freshmen. Several new studies indicate that multicomponent college/community and military/community interventions emphasizing environmental policy can reduce alcohol-related harms among underage college students.

Nonetheless, continued research is needed in all these areas, particularly minimally studied areas (e.g., prospective studies of alcohol and the developing brain; policy studies of use/lose laws, internal possession laws, and social host liability laws; elimination of drinking-age exceptions allowing parental alcohol provision to their own children; and family–parent interventions). Whether combining multiple interventions will be more effective than individual interventions warrants research attention, as does identifying which combination of interventions yields the greatest reductions with the least cost. Also, whether certain interventions are more likely to have carry-over benefits into adult life is a high research priority.

Since the surgeon general's *Call to Action*, underage drinking and related traffic deaths have continued declining in the United States, and research knowledge has expanded regarding the determinants and consequences of and ways to reduce underage drinking. Levels of underage drinking and associated harms, however, remain unacceptably high. Many knowledge gaps persist, and research is needed to develop and test more cost-effective strategies to reduce underage drinking and to widen implementation of interventions already demonstrated to reduce this problem. As new individuals constantly enter the population of those under age 21, strategies to prevent and delay drinking onset must continually be revisited and reinvigorated.

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