The Value of Prevention

Potential Cost Savings from Delaying Adolescent Alcohol Use in Wyoming

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ABOUT THIS REPORT

This publication was produced for the Wyoming Department of Health, Public Health Division.

CITATION

Nelson, N. M., Wambeam, R., & Canen, E. (2017). The value of prevention: Potential cost savings from delaying adolescent alcohol use in Wyoming. (WYSAC Technical Report No. CHES-1712). Laramie, WY: Wyoming Survey & Analysis Center, University of Wyoming.

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Introduction

The release of *The Surgeon General's Call to Action to Prevent and Reduce Underage Drinking* in 2007 made explicit the scope of the public health and safety problem stemming from underage alcohol consumption (U.S. Department of Health and Human Services [U.S. DHHS], 2007). In 2005, data from a national survey showed that by age 15, approximately half of young people had ever drunk alcohol (i.e., a whole drink), and by age 21, approximately 90 percent had a whole drink (U.S. DHHS, 2007). Data from the same survey also showed adolescents reporting fewer episodes of drinking in the past month than adults; however, when adolescents did drink, they consumed more alcohol than adults. Youth between the ages of 12 and 20 drank on average five drinks per occasion about six times a month. By comparison, adults 26 years of age and older drank on average two to three drinks per occasion about nine times a month (U.S. DHHS, 2007). For a 140-pound male, consuming five or more drinks in a row will result in a blood alcohol concentration (BAC) of approximately 0.13 gram percent, and a 120-pound female will have a BAC of approximately 0.20 gram percent (American Prosecutors Research Institute, 2003). The legal limit for driving after drinking is 0.08 gram percent.

The *Call to Action* also highlighted the association of early drinking onset with a range of social, emotional, behavioral, and health problems such as risky sexual behavior, car crash involvement, and unintentional injuries after drinking in both adolescence and adulthood (U.S. DHHS, 2007). Further, the *Call to Action* emphasized the long-term negative effects from alcohol on developing adolescent brains. Subsequent research continues to document the array of negative effects alcohol may have on adolescent neurocognitive development (Hingson & White, 2014; Lisdahl, Gilbart, Wright, & Shollenbarger, 2013).

Of particular importance to this study, the *Call to Action* presented findings on the increased likelihood of alcohol dependence among persons who began drinking before age 15 compared to those who started at 21 years or older (40 percent versus 10 percent, respectively). Alcohol use disorders are one of the most prevalent use disorders in the United States affecting 8.5 percent of adults in the last 12 months and 30.3 percent during their lifetimes (Hasin, Stinson, Ogburn, & Grant, 2007).

In this report, we base our estimates of the economic value of prevention on the association between early alcohol use onset and alcohol use disorders in adulthood. Specifically, we calculate the number of future alcohol use disorder cases avoided due to youth initiating alcohol use at an older age. We posit this delay is in response to prevention efforts in Wyoming communities and at the national level. We include prevention programs implemented at the national level because these efforts help to change the societal ethos regarding underage drinking and are nearly impossible to disentangle from state or local efforts. Next, we estimate the associated economic benefits (avoided costs) that arise from the prevention of future alcohol use disorder cases. The benefits of prevention are produced in the future by the avoidance of costs that would have been incurred had the disorder not been prevented.

What is the economic value of preventing future alcohol use disorders?

Background

Patterns of Alcohol Use Among Adolescents

NATIONAL

Since the *Call to Action* in 2007, data from national surveys have shown a steady decline in the percentages of 8th, 10th, and 12th graders who drink and have episodes of binge drinking (Hingson & White 2014). However, alcohol continues to be the most widely used substance by youth (Hingson & White 2014; Lisdahl, et al., 2013). In 2013, the median age at first use of alcohol was 14.5 years among 12 to 20 year olds, and nearly one in five (18.6 percent) high school students reported consuming their first drink before age 13 (Chen, Yi, & Faden, 2015). By the 12th grade, 22.1 percent of students reported binge drinking (consuming five or more drinks in a row) in the past two weeks (Chen, Yi, & Faden, 2015). Data from the 2013 National Survey on Drug Use and

Alcohol continues to be the most commonly reported substance used among all grade levels in Wyoming and across the Nation.

Health (NSDUH) showed all rates of past-month drinking, from use to binge drinking to heavy drinking, increased dramatically between ages 12 to 21 (Substance Abuse and Mental Health Services Administration [SAMHSA], 2014).

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Rates of alcohol consumption among Wyoming high school students are on the decline as shown in Figure 1 (YRBSS, 2015). However, similar to national data, alcohol continues to be the most commonly reported substance used among all grade levels in Wyoming (Canen, Hime, & Chavez, 2014).

Figure 1. Trends in Alcohol Consumption among High School Students is on the Decline

High school past 30-day current use and binge drinking rates
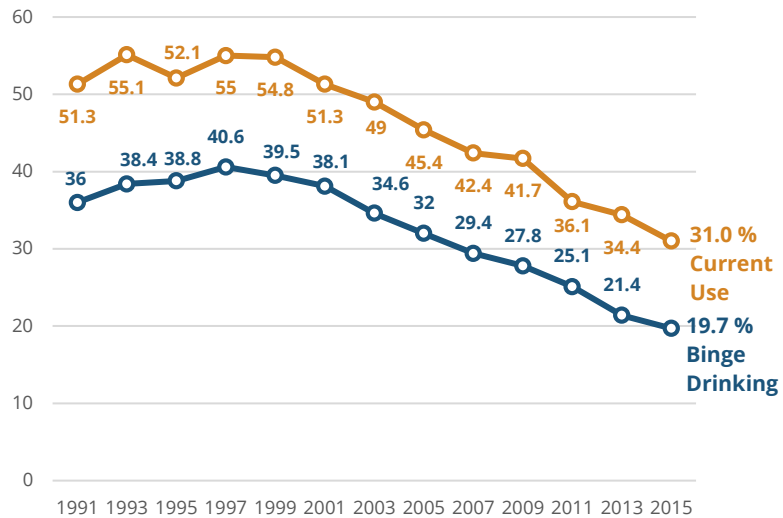
Source: Wyoming Youth Risk Behavior Surveillance System.

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Alcohol Consumption in Wyoming

In 2014, Wyoming consumed 1,292 thousand gallons of alcohol equaling 2.71 gallons per capita (Haughwout, LaVallee, & Castle, 2016). Wyoming's per capita consumption of alcohol is higher than the U.S. rate of 2.32 gallons per capita and ranks in the third decile of all states (one is the highest level, ten is the lowest level) (Haughwout, LaVallee, & Castle, 2016).

Alcohol-Related Consequences

The following are notable findings from the 2015 State Epidemiological Workgroup's summary report on alcohol-related data (WYSAC, 2016).

- Despite slight declines since 2008, during 2013, the overall DUI arrest rate in Wyoming was approximately double the national average (667 vs. 290, respectively).
- Although arrest rates for liquor law violations have been declining since 2008, during 2013, Wyoming's arrest rate was still approximately 5 times higher than the national average (476 vs. 96, respectively).

- In 2013, compared to the national average, Wyoming youth were approximately 6.5 times more likely to be arrested for liquor law violations (421 vs. 65).
- From 1995 to 2013, the percentage of high school students who reported drinking and driving had declined from 22 percent to 10 percent.
- Since 1995, there has been a pronounced decline in the percentage of high school students who reported riding in a car with someone who had been drinking (22 percent in 2013 vs. 42 percent in 1995).

History of Prevention in Wyoming and the Nation

The prevention of underage drinking in Wyoming began in the 1990's, and constituted education for parents and information dissemination at events such as health fairs. The small amount of prevention funding that came from the Substance Abuse and Mental Health Services Administration (SAMHSA) through the Prevention Block Grant or State funding was contracted to Wyoming's mental health providers who provided information and presentations on the dangers of underage drinking.

This all changed with the creation of the state Substance Abuse Division (SAD) in 2000, and receipt of the State Incentive Grant (SIG), discretionary funding from SAMHSA, in 2001. Wyoming Prevention Staff traveled the state helping to develop prevention coalitions in each county and promoting the Prevention Needs Assessment (PNA) survey of students. SAD collaborated with the Wyoming Department of Education on the project to provide evidence-based prevention and afterschool programming. In 2004, Wyoming received the Strategic

Wyoming communities have used mostly evidence-based strategies that impact the entire population.

Prevention Framework State Incentive Grant (SPF SIG) which further funded the efforts of local coalitions and broadened prevention efforts to include environmental strategies. Since then, Wyoming communities have pursued a comprehensive approach to preventing underage drinking using evidence-based strategies designed to impact the entire population.

In sum, at the start of the 21st Century, Wyoming moved from small, unproven efforts to the best prevention science available with significant funding from SAMHSA. Communities have spent more than 15 years providing prevention programming for youth, pursuing environmental strategies, and working to change local culture in an attempt to decrease

prevalence rates and associated negative consequences of underage drinking. Many of these changes mirror efforts that have been taking place across the nation.

Methods

Delay of Onset

Our analysis of the value of prevention in Wyoming is predicated on a large body of evidence that shows a correlation between age of first drink (also known as age of alcohol use onset) and a higher probability of developing an alcohol use disorder later in life (Dawson, Goldstein, Chou, Ruan, & Grant, 2008; DeWit, Adlaf, Offord & Ogborne, 2000; Grant & Dawson, 1997; Hingson, Heeren, & Winer, 2006; Ohannessian, Finan, Schulz, & Hesselbrock, 2015). Many researchers have interpreted the correlation as causal, while others believe early initiation and the ensuing problems simply have common risk factors (Kuntsche, Rossow, Engels, & Kuntsche, 2016; Maimaris & McCambridge, 2014; Prescott & Kendler, 1999). The authors

> **Research has shown a correlation between age of first drink and a higher probability of developing an alcohol use disorder later in life.**

of a systematic review of cohort studies concluded there was mixed evidence from a limited number of studies on the association between age of first drink and alcohol problems in adulthood (Maimaris & McCambridge, 2014). The authors advocate for developing "a very underdeveloped literature" to support evidence-based prevention efforts.

Despite lacking a clear understanding of the causal pathways between early onset and subsequent alcohol-related abuses in adulthood, Hingson, Zha, & White (2016) argue the delay of drinking onset as a prevention strategy is warranted given the speed at which adolescents transition from first drink to first episode of drunkenness.

In our determination of future alcohol use disorder cases prevented, we use estimates of alcohol use disorders expected by year of age of alcohol use onset for the "nonblack" subsample as reported by Grant and Dawson (1997). The study used data from the National Longitudinal Alcohol Epidemiologic Survey, a survey designed to be representative of the adult, noninstitutionalized population of the contiguous United States, to estimate prevalence rates for

lifetime alcohol dependence and abuse for each year of age of alcohol use initiation (Grant & Dawson, 1997).

Alcohol Onset Measure

Data on drinking initiation (alcohol use onset) are collected as part of the PNA, a survey designed to gather information for the planning and evaluation of substance abuse prevention programs, policies, and practices in Wyoming. The PNA is administered biennially as a census of all enrolled 6th, 8th, 10th, and 12th grade students in the state of Wyoming (Canen, Hime, & Chavez, 2014). Age of alcohol use initiation is measured by asking students the following: "How old were you when you first had more than a sip or two of beer, wine, or hard liquor?" We chose this measure because it reflects the measurement used by Grant and Dawson (1997) in their study examining the relationship between age at first use of alcohol and lifetime prevalence of alcohol abuse and dependence. Age of drinking onset is measured in Grant and Dawson's study by asking respondents "how old they were when they first started drinking, not counting small tastes or sips of alcohol" (page 105).

Baseline Trend

Given the data are observational, our assessment of the effect of prevention efforts on underage drinking in Wyoming relies on establishing a valid counterfactual (i.e., how many students would have initiated alcohol use as an adolescent had there been no prevention efforts in Wyoming or at the national level). In order to demonstrate and then estimate the unobservable counterfactual scenario of a baseline trend, we use data from the PNA and the Youth Risk Behavior Surveillance System (YRBSS) surveys.

The PNA was first conducted in Wyoming during the fall of the 2001-2002 school year (henceforth referred to as the 2001 PNA data). Evidence-based prevention strategies aimed at reducing underage drinking in Wyoming were initiated around that same time with the receipt of SIG funding. Hence, we can use 2001 PNA data as our baseline for initiation of alcohol use among adolescents in the absence of prevention. Our basis for using 2001 data as our reference condition is validated using data from the YRBSS, a survey designed to monitor various health-risk behaviors including alcohol use. The YRBSS data set for Wyoming extends back to 1991. Using measures of past-month alcohol use and binge drinking, we estimate a trend line from 1991 to 2001 for these behaviors as shown by the dashed lines in Figure 2. An analysis of the

slope of the trend line for either measure shows the slope is neither increasing nor decreasing (i.e., not statistically different from zero; see Appendix A for details). In using 2001 PNA data as the reference condition, we also assume there are no systematic differences between students in 2001 and 2014 that are associated with the age of alcohol use onset.

Figure 2. Predicted Trends in Alcohol Consumption in the Absence of Prevention are Flat

Counterfactual trends in past-30 day current use and binge drinking rates
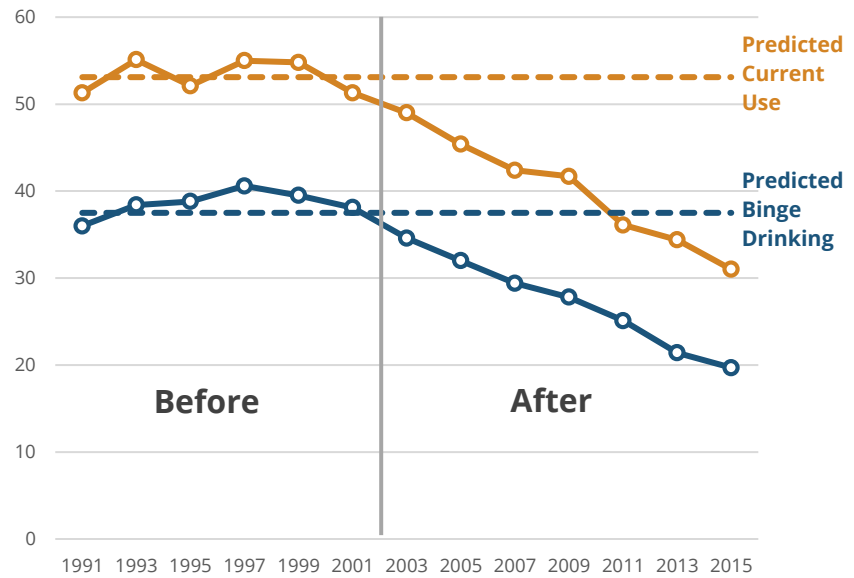
Source: Wyoming Youth Risk Behavior Surveillance System.

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Data Analyses

PERSPECTIVE OF THE ANALYSIS

Alcohol use disorders impose significant costs on society by producing a myriad of negative outcomes, including productivity losses, healthcare and specialty treatment costs, property damage due to alcohol-related crimes, motor vehicle accidents, and criminal justice costs including policing, legal and adjudication, and corrections. The widespread burden of cost justifies our use of a societal perspective in conducting the analysis herein. Benefits reported in this study are derived using the human capital approach, which assumes an individual's expected future earnings reflect his or her potential

Alcohol use disorders impose significant costs on society justifying the use of a societal perspective for this analysis.

contribution to the economy (Tarricone, 2006). The human capital approach is not all-inclusive, excluding the costs associated with pain and suffering and the value of leisure time. It may also undervalue the productivity of groups whose productivity value is not reflected in earnings (e.g., volunteers; Haddix, Corso, and Gorsky, 2003). Hence, the benefits we present in this report should be considered as a lower-bound estimate of the avoided economic costs associated with alcohol use disorders.

ESTIMATES OF ALCOHOL USE DISORDER CASES PREVENTED

We follow the methodology used by Spoth, Guyll, and Day (2001) to estimate the number of future alcohol use disorder cases prevented among 12th grade students in 2014. Data from the 2014 senior class represent a one-year cohort of individuals to which the change in the number of alcohol use disorder cases resulting from prevention is applied over the lifetime of an average adult. Estimating the benefits of prevention using a single one-year cohort simplifies the calculation because we know a student's drinking onset status in the months prior to or just after becoming an adult, the period of life we focus on in this analysis. In addition, a primary concern with self-reported data is the well-documented inconsistencies in reporting age of drinking initiation that occurs in longitudinal studies (Kuntsche, Rossow, Engels, & Kuntsche, 2015). By limiting our analysis to high school seniors we hope to reduce the potential for confounding introduced by "telescoping forward" recall, the tendency to report age of alcohol use initiation closer to one's current age (Kuntsche, Rossow, Engels, & Kuntsche, 2015, page 959).

We use 2001 and 2014 PNA data to obtain the number of 12th grade students who initiated alcohol use at a particular age (i.e., 12 or younger, 13, 14, 15, 16, 17, and 18 or older). The 2001 PNA data serve as our reference condition (i.e., the trend in alcohol initiation in the absence of prevention), and the 2014 PNA data serve as the change in alcohol initiation as a result of prevention efforts in Wyoming communities and at the national level. For each age, the total number of alcohol use initiation is multiplied by the proportion of future alcohol use disorders expected as reported by Grant and Dawson (1997) to obtain the projected number of cases. The proportion of students who reported never using alcohol by their senior year (typically 17 to 18 years of age) are grouped into the alcohol onset age category of 18 and older. Further, the lifetime alcohol use disorder rate for the 18 and older age category is the average of Grant and Dawson's (1997) prevalence rates for the 18 to 25+ age groups. The total number of future alcohol use disorder cases expected for the 2001 and 2014 twelfth grade classes is the sum of expected cases at each age. Finally, the number of alcohol use disorder cases prevented in adolescence is the difference between the expected rate per 100 students in 2001, the counterfactual or reference condition, and the expected rate per 100 students in 2014.

ESTIMATES OF AVERAGE AVOIDED COSTS

Assessing the benefits realized by the prevention of an alcohol use disorder in adolescence requires the calculation of the present value of future benefits. These future benefits represent the avoided costs that would have been incurred by an individual over the time period they engaged in disordered behavior. The societal cost of alcohol abuse and dependence to Wyoming in 2010 was approximately $843 million, as estimated by WYSAC using a cost of illness (COI) framework (WYSAC, 2012). For the estimation of benefits from prevention, we assume the costs of alcohol use disorders to Wyoming are produced by individuals who are currently disordered.

The societal cost of alcohol abuse and dependence to Wyoming in 2010 was approximately $843 million.

We estimate the average cost per alcohol use disorder case using prevalence estimates from the 2009-2010 NSDUH estimates for alcohol dependence or abuse in the past year, the same year as the COI study (SAMHSA, 2011). We then use the average cost per alcohol use disorder in our estimation of the present value of benefits due to prevention.

Because a dollar is valued more highly today than a dollar in the future, we must discount the future benefits that accrue from prevention. For each year of age, we estimate the present value of the average benefit (i.e., avoided costs) realized by the prevention of an alcohol use disorder. The total present value of the entire benefit from preventing a single alcohol use disorder is the sum of benefits from the beginning of the disordered behavior until cessation of disordered behavior, discounted by three percent per year (a standard assumption in the field of economics). We assume the earliest an adult alcohol use disorder could commence is age 18 and could extend to 78.8 years of age, the average life expectancy of an adult (Arias, Heron, & Xu, 2016).

However, the counterfactual behavior at the time a disorder is prevented in adolescence is unobservable. That is to say, we do not know at what age the disordered behavior would have begun nor for how long the disordered behavior would have lasted. To account for this unobservable behavior, we apply a probability distribution of engaging in disordered alcohol use by age to the present value of the cumulative benefits by age. The sum of this product over the average adult life expectancy (i.e., from 18 to 78.8 years) is the present value of the total lifetime benefit realized by the prevention of a single alcohol use disorder. Our probability distribution is based on a model developed by the Washington State Institute for Public Policy (WSIPP) to estimate the expected current 12-month prevalence of an alcohol use disorder over

the lifetime of a general population of one year olds (2016; see Appendix B for details). WSIPP's model accounts for lifetime prevalence, age of onset, persistence of the disordered behavior given onset, and probability of survival. We convert the expected current 12-month prevalence distribution into a probability distribution using 2014 population estimates by single year of age (U.S. Census Bureau, 2016).

SENSITIVITY ANALYSIS

The estimation of benefits from prevention involves a number of parameters, nearly all of which contain uncertainty. Parameter uncertainty arises from the nature of conducting studies including sample size, variance in the data, the existence of multiple studies, generalizability of study results to the real world, and other factors. We complete a deterministic sensitivity analysis, varying one parameter at time, to examine the robustness of our benefit estimates given parameter uncertainty. For instance, in reporting prevalence rates, SAMHSA provides 95 percent Bayesian confidence intervals. We use these reported confidence intervals to calculate lower and upper estimates of the average cost per disordered individual. We also adjust the discount rate to examine the effect the future value of money will have on the present value of benefits.

Results

Projected Number of Alcohol Use Disorders

Table 1 shows the distribution of alcohol use initiation by age for the 2001 and 2014 high school senior classes. Also reported in Table 1 is the projected life-time alcohol use disorder rate, which is equal to the projected number of disorder cases divided by the total number of 12th grade students enrolled at the beginning of the academic year. The projected disorder rate for the 2001 class, (43.9), minus the projected disorder rate for the 2014 class, (37.6), equals the number of alcohol use disorder cases prevented per 100 high school seniors, or 6.3. The total number of disorder cases prevented in 2014 equals the rate, (6.3), times the total number of 12th grade students enrolled, (6,176), yielding 389 cases.

389 cases of future alcohol use disorders prevented in 2014.

Table 1: Projected Number of Alcohol Use Disorders Averted

Age of alcohol use initiation	Lifetime alcohol use disorder rate (1)	2001		2014	
		Number initiating alcohol use (2)	Projected number of disorder cases (1 x 2)	Number initiating alcohol use (3)	Projected number of disorder cases (1 x 3)
12 and younger	49.4%	1776	877.2	910	449.4
13	59.6	755	449.9	378	225.3
14	55.5	842	467.5	594	329.7
15	51.6	999	515.4	727	375.1
16	41.7	801	334.2	843	351.5
17	34.4	396	136.1	690	237.3
18 and older	17.5[a]	1263	220.9	2034	356.0
Total number of alcohol use disorder cases projected			3,001.2		2,324.4
Total number of 12th grade students enrolled		6,832		6,176	
Projected lifetime alcohol use disorder rate [b]		43.9% (0.6)		37.6% (0.62)	
Number of alcohol use disorder cases prevented per 100 students			6.3		
Total number of alcohol use disorder cases prevented in 2014			389		

[a] The lifetime alcohol use disorder rate for 18 and older is the average of the rates for the 18 to 25+ age groups as reported by Grant and Dawson (1997).

[b] Values in parentheses represent the standard errors.

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Average Cost per Disordered Case

In 2010, alcohol use disorders cost Wyoming $843,220,902 (WYSAC, 2012). We calculate the average cost per disordered individual to be $22,835 using prevalence estimates for past year alcohol dependence or abuse from the 2009-2010 NSDUH (see Table 2).

Table 2: Average Cost per Alcohol Use Disorder

	2010 population (1)	Prevalence rate [a] (2)	Currently disordered individuals (1 x 2)
12 to 17	43,392	5.86%	2,543
18 to 25	64,873	17.94	11,638
26 and older	363,351	6.26	22,746
Total number of alcohol use disorder cases			36,927
Total cost of alcohol misuse, 2010			$843,220,902
Average cost per disordered individual			$22,835

[a] Prevalence rate estimate for past year alcohol dependence or abuse from 2009-2010 NSDUH.

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Benefit Estimate

As described in the Methods section, our benefit estimate of preventing a single alcohol use disorder is based on probability distribution of engaging in disorder drinking derived from the expected 12-month prevalence of an alcohol use disorder across the lifetime of a cohort of one year olds. We then apply the probability of an alcohol use disorder to the distribution of benefits that accrue over the lifetime of an individual for whom an alcohol disorder is prevented, discounted to present value using a rate of 3 percent. Using this approach, the resulting estimate of the present value of total lifetime benefit realized by the prevention of a single alcohol use disorder is $313,698.50. Multiplying the number of future alcohol use disorder cases prevented (389 cases) by the estimate of benefits from preventing a single disorder ($313,698.50) equals the potential economic benefit of delaying the onset of alcohol use for the 2014 senior high school class or $122,015,701.

The potential economic benefit of delaying the onset of alcohol use is $122 million for the 2014 senior high school class.

Sensitivity Analysis

We examine the effect of uncertainty in the prevalence estimates of past year alcohol dependence or abuse as reported by SAMHSA for the state of Wyoming. This uncertainty in the number of individuals with past year alcohol dependence or abuse changes the estimate for the average cost per disordered individual. As shown in Table 3, the lower bound estimate of prevalence rates results in a fewer individuals with an alcohol use disorder which increases the average cost per disordered individual and vice-versa for the upper bound estimates of prevalence rates.

Table 3: Lower and Upper Bound Estimates of the Average Cost per Alcohol Use Disorder

		Prevalence rates [a]		Currently disordered individuals	
	2010 population (1)	Lower bound (2)	Upper bound (3)	Lower bound (1 x 2)	Upper bound (1 x 3)
12 to 17	43,392	4.54%	7.53%	1,970	3,267
18 to 25	64,873	15.41	20.78	9,997	13,481
26 and older	363,351	4.95	7.90	17,986	28,705
Total number of alcohol use disorder cases				29,953	45,453
Total cost of alcohol misuse, 2010					$843,220,902
Average cost per disordered individual				$28,152	$18,552

[a] Prevalence rate estimates are the 95% confidence intervals for past year alcohol dependence or abuse from 2009-2010 NSDUH.

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Table 4 summarizes the results of accounting for parameter uncertainty in the prevalence rate estimates and the effect of adjusting the discount rate in calculating the present value of future benefits. The sensitivity analysis shows the benefits of preventing a single case of an alcohol use disorder are sizeable after varying two key variables.

Table 4: Results of Sensitivity Analysis are Robust

	Present value of preventing a single alcohol use disorder
Base case value	$313,698
Prevalence rates	
Lower 95% confidence interval	$386,737
Upper 95% confidence interval	$254,855
Discount rate	
2.5% per year	$367,835
5% per year	$176,268

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Limitations of the Study

The estimate from the Wyoming COI study on the total cost of alcohol use disorders did not account for the possibility that drinking by adolescents may lead to diminished academic performance and early termination of schooling (Hingson & Kenkel, 2004). Poor academic performance as well as reduced educational attainment is known to affect future wages. Alcohol use among minors has also been associated with a higher incidence of unprotected sex, resulting in higher rates of AIDS, other sexually transmitted diseases, and unplanned pregnancy (Hingson & Kenkel, 2004). The costs associated with these negative outcomes were not included in the Wyoming COI study.

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Appendix A – Baseline Trend Analysis

Data on alcohol use initiation among 12th grade students were first collected in 2001 as part of the Prevention Needs Assessment (PNA). Prevention efforts focused on underage drinking in Wyoming began with receipt of the State Incentive Grant (SIG), discretionary funding from SAMHSA, in 2001. Hence, we use data from two related measures of alcohol use – past-month alcohol use and binge drinking – for which we have data from 1991 to 2014 to establish the baseline trend in alcohol use initiation among 12th grade students in the absence of prevention (the counterfactual).

We use a simple linear model to estimate the trend in past-month alcohol use and binge drinking from 1991 to 2014 among 12th grade students.

Where,

$$Alcohol = \ \beta_0 + \beta_1 Year + \beta_2 Tx + \beta_3 YrTx$$

where

> *Alcohol* is the percentage of 12th graders who reported past-month alcohol use or binge drinking.

> *Year* is the year in which the data on the 12th grade class was collected, normalized to 1991.

> *Tx* is a dummy variable representing prevention efforts to curb underage drinking in Wyoming, which takes the value of one if the year is 2002 or later, zero otherwise.

> *Yrtx* is an interaction term between year of data collection and efforts at prevention.

The counterfactual trend is represented by the slope of the line previous to prevention efforts (i.e., Tx is equal to zero). Thus, the trend in alcohol use initiation in the absence of prevention is the estimated coefficient for *Year* or β_1. Results of the analysis are presented below in Table A-5. In both models, the estimated coefficient for *Year* is not significant indicating the slope is zero for the counterfactual trend.

Table A-5: Model output for past-month alcohol use and binge drinking

	Past-month alcohol use		Past-month binge drinking	
	coefficient	p-value	coefficient	p-value
Year	0.03	0.88	0.22	0.11
Tx	13.33	<0.001	12.25	<0.001
YrTx	-1.50	<0.001	-1.48	<0.001
constant	53.12	<0.001	37.45	<0.001
R square	0.97		0.98	

Appendix B – WSIPP's Model for Estimating Current Prevalence of Alcohol Use Disorders

The Washington State Institute for Public Policy (WSIPP) prepared technical documentation describing the computational procedures used in their Benefit-Cost Model (WSIPP, 2016). We follow their procedure for estimating the current prevalence of ATOD (alcohol, tobacco, and other drugs) use in Section 4.4a. Please see their documentation for details regarding model development.

The model requires four parameters to estimate current prevalence of ATOD, in this case alcohol use disorder, from age one to 100.

- Lifetime prevalence of disordered alcohol use;
- Age of onset of disordered alcohol use;
- Persistence given onset; and
- Survival or the probability of death.

The primary equation governing this model as developed by WSIPP is as follows:

$$CPG_y = \left(\sum_{O=1}^{y} O_O \times P_{(y-O+1)} \right) \times LTP \times S_y \times SF_a$$

The first terms in parentheses include the age-of-onset probability, O, from prior ages to the current age of the person, multiplied by the persistence probability, P, of remaining in the condition at each onset age. The third term, LTP, is lifetime probability of ever having an alcohol use disorder (AUD). The fourth term, S_y, is the probability of any-cause survival and the final term, SF_a, is the probability of AUD-related survival in each age group.

Table B-6 presents the input parameters we use for estimating the current prevalence of an alcohol use disorder over the lifetime of a general population of one-year olds for Wyoming. Figure B-3 shows the resulting the expected current 12-month prevalence of an alcohol disorder during the lifetime of a general population of one-year olds in Wyoming as computed with the equation above.
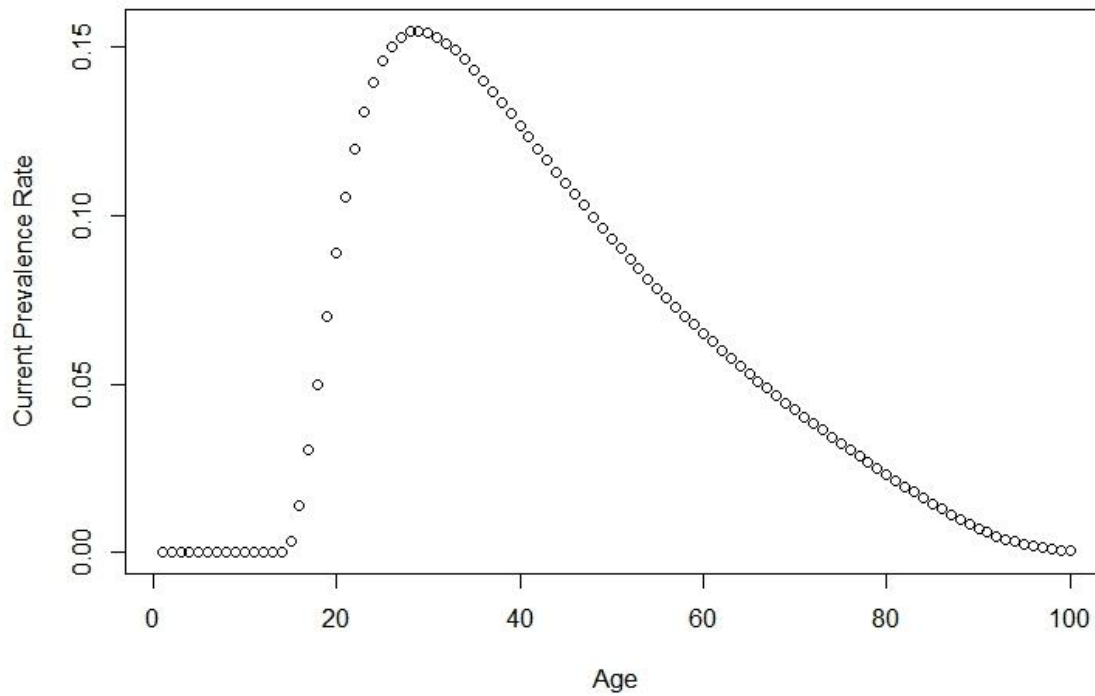
Table B-6: Input parameters for estimating the current prevalence of alcohol use disorder

	Alcohol Use Disorder
Percentage of population with lifetime alcohol use disorder	29.1%
Age of onset (Log-logistic distribution)	
Shape parameter (α)	2.05
Scale parameter (β)	8.0661
Shift parameter (γ)	14.5776
Persistence of disorder (Weibull distribution)	
Shape parameter (α)	0.86728
Scale parameter (β)	24.129
Shift parameter (γ)	0.5

Source: WSIPP, 2016

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Figure B-3. Computed Distribution of Alcohol Abuse and Dependency, Wyoming General Population