Contribution of Alcohol-Impaired Driving to Motor Vehicle Crash Deaths in 2010

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Abstract

Although it is well-known that alcohol-impaired driving increases crash risk, the number of crash deaths specifically attributable to alcohol-impaired driving is less well known. Many fatal crashes occur with sober drivers, and many fatal crashes of drinking drivers would still have occurred if they had not been drinking. In order to understand what is possible with different countermeasures — for example, those aimed at convicted offenders or high blood alcohol concentration (BAC) drivers versus those targeted at the general population of drivers — it is important to know how much of the problem is accounted for by these different target populations.

In this paper we describe a calculation procedure for estimating the number of crash fatalities in the 2010 Fatality Analysis Reporting System (FARS) attributable to different driver BACs. The procedure first classifies all fatalities by the highest BAC for driver(s) involved in the crash. Then, using the risk curve developed by Zador et al.,[1] the number of fatalities specifically attributable to the high BACs is estimated.

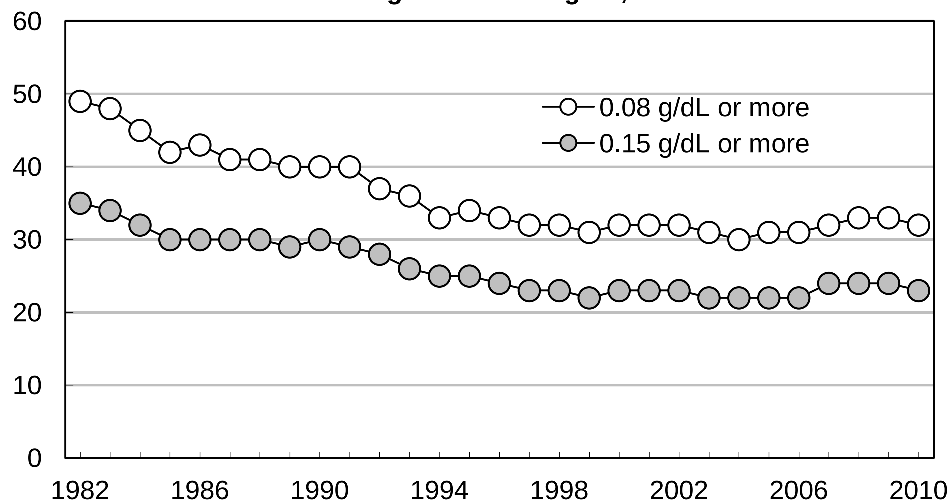
It is estimated that drivers with BACs at or above 0.08 g/dL were involved in the deaths of 10,228 road users in the United States in 2010 and that, had all these drivers had BACs below 0.08 g/dL, 7,082 of these deaths would have been prevented — this is the number attributable directly to BACs at or above 0.08 g/dL. Had all drivers had BACs below 0.05 g/dL, an estimated 8,770 deaths would have been prevented. If all drivers in 2010 had had zero BACs, as many as 10,600 deaths would have been prevented. If all drivers with at least one alcohol-impaired driving conviction within 3 years prior to the crash were restricted to BACs below 0.08 g/dL, 552 deaths could have been prevented in 2010.

Keywords: DWI deterrence; Ignition interlocks; Alcohol-impaired crashes; Blood alcohol concentration

Introduction

In the United States, substantial progress to reduce alcohol-impaired driving was made during the 1980s and early 1990s, but progress stalled in the mid-1990s and alcohol-impaired driving remains a major crash factor (Figure 1). In 2010, 10,228 people died in crashes where at least one driver had a blood alcohol concentration (BAC) of 0.08 g/dL or above — BACs considered illegal in all U.S. States. This represented 31 percent of all crash deaths. These statistics are based on data from the Fatality Analysis Reporting System (FARS), a database of information on motor vehicle fatalities on U.S. public roads. BACs are based on the value resulting from a blood alcohol chemical test or, if test results are missing, an imputed BAC value.[2]

Figure 1
Percent of Fatally Injured Drivers with BACs at or above 0.08 g/dL and 0.15 g/dL, 1982-2010



The declines in alcohol-impaired driving during the 1980s are due in part to strong new laws and strong enforcement of those laws, which increased the perceived likelihood that alcohol-impaired driving could be detected and punished. Careful studies have shown that administrative license suspension, which increases the likelihood of sanctions if caught, has reduced alcohol-impaired crashes. So have laws that define offenses on the basis of BAC per se (thereby making it easier to prove violation of the law).[3] Sobriety checkpoints also are effective. A 2002 review of 23 U.S. studies of sobriety checkpoint programs found a median decline of 22 percent in fatal crashes thought to involve alcohol.[4] Other studies show that checkpoints can be very efficient with small demands on police manpower.[5,6] Despite these successes, many jurisdictions may be reaching the limit of their resources for detecting and punishing alcohol-impaired driving. From 2005 to 2009 the number of arrests for alcohol-impaired driving showed little change, hovering between 920,000 and 950,000.[7,8]

The weakness of the enforcement model is that, despite improvements in U.S. laws, it still is difficult to detect and arrest alcohol-impaired drivers once they are driving. The estimated chance of arrest when driving with an illegal BAC is less than 1 in 50.[9] It has long been recognized that a better strategy is to identify impaired drivers before they start the car and prevent them from driving. Unfortunately, the devices available to measure impairment have not had the reliability and specificity necessary to achieve acceptance. Research in the 1970s and 1980s focused on identifying impaired drivers using psychomotor performance tests, such as the critical tracking or reaction time tests, and it was shown that test performance decreased with increasing amounts of alcohol.[10,11] In 1973, a U.S. Department of Transportation report detailed an evaluation of "alcohol safety interlock systems." Although BAC was identified as a possible measure for an interlock device, no BAC-based systems were available at the time. Instead, all systems determined impairment based on performance of one or more tasks.[12] A key weakness was that many factors other than alcohol could produce similar decrements in task performance (e.g., stress associated with a medical emergency might cause hands to shake and performance to suffer).

The development of portable, reliable breath alcohol measurement devices in the 1970s enabled progress to continue toward alcohol ignition interlocks. These devices were specific to alcohol, and today almost all states have laws that restrict some offenders from driving unless their vehicles have been equipped with ignition interlocks. Until recently, these laws pertained to repeat offenders or to first offenders with very high BACs (e.g., 0.15 g/dL or higher). However, ignition interlock requirements for all offenders who either fail or refuse the alcohol breath test now are in place in 15 states. Ignition interlock license restriction programs have been shown to be effective at reducing recidivism among drivers with multiple alcohol offenses, at least while the restriction is in effect.[13] In 2006 an estimated 100,000 interlocks were in use throughout North America.[14]

Although more promising (specific) than behavioral impairment tests, current breath-based interlock technologies still have many inconvenient features (slow readings, frequent calibrations, mouthpiece care) that make them inappropriate for application to the vehicle fleet outside of convicted offenders or commercial fleets. However, more sophisticated technologies are being developed that have the potential to test driver BACs accurately, quickly, and unobtrusively (e.g., passive transpiration, tissue spectroscopy, micro-interstitial fluid tests). The promise of these technologies has led to a broad effort in the U.S. to find ways to facilitate its development.[15]

This paper explores the possible outcome of more widespread use of alcohol interlock devices in cars. We quantify the potential reduction in deaths with more widespread use of interlocks that would prohibit driving at or above various BAC thresholds. We also compare the effectiveness of general application of the technology to the vehicle fleet and to only populations of convicted alcohol-impaired driving offenders.

Method

Zador et al.[1] estimated the relative risk (RR) of driver involvement in fatal crashes by age (16-20, 21-34, 35+) and gender as a function of driver BAC, using 1995-96 FARS crash data and exposure data from the 1996 National Roadside Survey of Drivers. They estimated the risk of fatal crash involvement relative to a similar driver with no blood alcohol as:

RR = exp(35.324*BAC) for male drivers age 16-20, (1)
RR = exp(19.541*BAC) for female drivers age 16-20, (2)
RR = exp(20.358*BAC) for all drivers age 21-34, (3)
RR = exp(20.147*BAC) for all drivers age 35 and over. (4)

For example, the estimated risk of fatal crash involvement for a teenage male driver with BAC exactly 0.05 g/dL is 5.849 times the risk for a teenage male driver with zero BAC.

The risk curve reported by Zador et al. also predicted lower risk for those with 0.01 g/dL BAC than for those with zero BAC, similar to the dip found in the Grand Rapids Study by Borkenstein et al.[16] The authors noted that such a dip is customarily assumed to be due to “differing alcohol tolerance between crash-involved and non-crash-involved drivers.” Hurst[17] reported that controlling for self-reported drinking frequency eliminated the dip in the Grand Rapids Study. In the current analysis drivers with BAC below 0.02 g/dL are assumed to have the same risk as those with zero BAC.

Using FARS data for 2010, fatal crashes were classified by the highest driver BAC and the corresponding gender and age category of that driver. BACs were based on alcohol test results, if available, or imputed BAC values. Relative risks were computed using the logistic regression coefficients above, with BAC values 0.035, 0.065, 0.090, 0.125, and 0.150 g/dL representing the five BAC categories 0.02-0.04, 0.05-0.07, 0.08-0.09, 0.10-0.14, and 0.15+ g/dL. Based on the estimates of relative risk for a given driver group (highest driver BAC category, gender, and age category), eliminating alcohol in the driver’s blood should lower fatal crash involvement risk by (1 – 1 / RR). Multiplying this quantity by the number of deaths for a given category of highest driver BAC and gender/age category yielded the estimated number of lives potentially saved if the BACs were reduced to zero.

Risks relative to a given BAC other than zero were computed using the same logistic regression coefficients as equations (1)-(4) but multiplying these by the differences in the BACs. This is equivalent to computing the ratio of the relative risks for each BAC.

Results

Table 1 summarizes the potential lives saved for various groups of drivers if the BAC of the highest BAC driver had been zero (for this analysis, any BAC below 0.02 is treated as zero). For example, a teenage male driver with BAC between 0.02 and 0.04 g/dL has a fatal crash involvement risk 3.443 times as high as that of the same driver with zero BAC. Lowering that driver’s BAC to zero should lower the risk of involvement in a fatal crash by approximately (1 – 1 / 3.443) = 0.710, or 71 percent. In 2010 an estimated 68 deaths occurred in crashes involving teenage male drivers with 0.02-0.04 g/dL BACs and no drivers with higher BACs. So, if these drivers had zero BAC, approximately (68)(0.710) = 48 deaths could have been prevented.

Similarly, eliminating the blood alcohol of teenage male drivers with BACs 0.05-0.07, 0.08-0.09, 0.10-0.14, and 0.15+ g/dL could have prevented another 66, 62, 224, and 423 deaths, respectively (Table 1). If all teenage male drivers with BACs of 0.02 g/dL or higher had instead a zero BAC, about 823 deaths could have been prevented. If all drivers of all ages, both male and female, had zero BACs, approximately 10,600 of the 32,885 highway crash deaths in 2010 could have been prevented.

Table 1
Potential Lives Saved in 2010 in United States if All Driver BACs Were Reduced to Zero

Highest driver BAC in crash (g/dL)	Driver gender, age	Relative risk of fatal crash	Reduction in risk with zero BAC	2010 Deaths	Potential lives saved with zero BAC
0.02-0.04	Male, 16-20	3.443	0.710	68	48
0.05-0.07		9.935	0.899	73	66
0.08-0.09		24.028	0.958	65	62
0.10-0.14		82.728	0.988	226	224
0.15+		200.070	0.995	426	423
0.02-0.04	Female, 16-20	1.982	0.495	13	7
0.05-0.07		3.561	0.719	23	16
0.08-0.09		5.805	0.828	24	20
0.10-0.14		11.503	0.913	61	56
0.15+		18.748	0.947	135	128
0.02-0.04	Both, 21-34	2.039	0.510	264	134
0.05-0.07		3.756	0.734	371	272
0.08-0.09		6.248	0.840	282	237
0.10-0.14		12.740	0.922	1,037	956
0.15+		21.194	0.953	3,055	2,911
0.02-0.04	Other/Unknown	2.024	0.506	318	161
0.05-0.07		3.705	0.730	372	272
0.08-0.09		6.130	0.837	330	277
0.10-0.14		12.409	0.919	1,058	972
0.15+		20.534	0.951	3,530	3,358
0.02+				11,731	10,600

According to Equation (1), the risk of fatal crash involvement for a teenage male driver with BAC exactly 0.05 g/dL is 5.849 times the risk for a teen male driver with zero BAC. Thus the risk for a teenage male driver with BAC between 0.05 and 0.07 g/dL relative to BAC 0.05 g/dL is simply the relative risk of Table 1 divided by 5.849, i.e., 9.935 / 5.849 = 1.699. The estimate of deaths that could have been prevented had these driver BACs been below 0.05 g/dL is (1 – 1 / 1.699) (73) = 30.

If all drivers had a BAC below 0.05 g/dL, at least 8,770 deaths could have been prevented (Table 2). Similarly, if all drivers had a BAC below 0.08 g/dL, that could have prevented at least 7,082 deaths in 2010. Going through the same calculations using the 95 percent confidence limits of the relative risks from Zador et al.[1] yields 95 percent confidence intervals (CIs) for the lives that could have been saved.

Table 2
Potential Lives Saved in 2010 if All Drivers Were Restricted to Various BAC Levels

Highest driver BAC in crash (g/dL)	2010 deaths	Potential lives saved if BACs reduced to: Zero	Below 0.05 g/dL	Below 0.08 g/dL
0.02-0.04	663	350	0	0
0.05-0.07	839	626	231	0
0.08-0.09	702	596	402	135
0.10-0.14	2,382	2,208	1,893	1,468
0.15+	7,145	6,820	6,244	5,479
0.02+	11,731	10,600	8,770	7,082
(95% CI)		(10,213, 10,851)	(8,256, 9,141)	(6,535, 7,513)

FARS records for each driver indicate the number of alcohol-impaired driving convictions within the 3 years prior to the crash. In 2010, 1,310 drivers in fatal crashes had at least one alcohol-impaired driving conviction in the prior 3 years. Using similar calculations, if all drivers with prior alcohol-impaired driving convictions within the past 3 years were restricted to zero BAC, approximately 785 deaths could have been prevented in 2010 (Table 3). If they were restricted to below 0.05 g/dL BAC, approximately 669 deaths could have been prevented. If they were restricted to below 0.08 g/dL BAC, approximately 552 deaths could have been prevented.

Table 3
Potential Lives Saved in 2010 if All Drivers with Prior DWI Convictions (within 3 Years) Were Restricted to Various BAC Levels

Highest driver BAC in crash (g/dL)	2010 deaths	Potential lives saved if BACs reduced to: Zero	Below 0.05 g/dL	Below 0.08 g/dL
0.02-0.04	33	18	0	0
0.05-0.07	45	34	12	0
0.08-0.09	32	27	18	5
0.10-0.14	146	135	115	89
0.15+	600	571	524	458
0.02+	856	785	669	552
(95% CI)		(760, 802)	(635, 694)	(515, 584)

If all drivers with multiple prior alcohol-impaired driving convictions were restricted to zero BAC, approximately 143 deaths could have been prevented in 2010 (Table 4). In 2010, 230 drivers involved in fatal crashes had multiple prior alcohol-impaired driving convictions. If they were restricted to below 0.05 g/dL BAC, approximately 125 deaths could have been prevented. If they were restricted to below 0.08 g/dL BAC, approximately 104 deaths could have been prevented.

Table 4
Potential Lives Saved in 2010 if All Drivers with Multiple Prior DWI Convictions (within 3 Years) were Restricted to Various BAC Levels

Highest driver BAC in crash (g/dL)	2010 deaths	Potential lives saved if BACs reduced to		
		Zero	Below 0.05 g/dL	Below 0.08 g/dL
0.02-0.04	2	1	0	0
0.05-0.07	8	5	2	0
0.08-0.09	5	4	3	1
0.10-0.14	28	26	22	17
0.15+	113	107	98	86
0.02+	156	143	125	104
(95% CI)		(140, 146)	(119, 131)	(98, 109)

Discussion

Alcohol-impaired driving is a major impediment to the reduction of motor vehicle crash fatalities and injuries. With new technology, it may soon be possible to prevent alcohol-impaired drivers from operating vehicles through easy, accurate, and unobtrusive BAC measurements. The analyses in this paper indicate that the potential benefit of any new technology depends on how broadly it is deployed.

Currently, alcohol interlock devices are specified principally for repeat offenders. These analyses indicate that if only those drivers with repeat alcohol-impaired driving offenses during the past 3 years were required to have these devices and if BACs were required to be zero (or below 0.02 g/dL), we could prevent about 143 fatalities in a year like 2010. If all drivers convicted of alcohol-impaired driving in the past 3 years were targeted and required to have zero BACs, the potential benefit jumps more than 5-fold, to 785 deaths prevented. However, if the technology could be applied to all drivers, restricting them to alcohol-free driving, then the benefit would jump another 13-fold, to 10,600 lives saved. Even if the general population were restricted to driving only with BACs less than the legally mandated 0.08 g/dL, the saving of lives would be 7,082 in a year like 2010.

Alcohol interlock devices can be important for dealing with the enormous problem of alcohol-impaired driving. However, there are two potential and opposite sources of concern. On the one hand, the general public may respond that this is too much “big brother.” The car is telling its owner if the owner is capable of driving. However, the risks when alcohol and driving mix are clear — if we can prevent impaired drivers from starting their cars, then many lives will be saved. If society decides not to be “big brother” then it is deciding to be the grim reaper, instead, as the deaths are tallied.

Some in highway safety also may have misgivings about the advent of new technology. They may fear damage to the progress that has been made in getting model laws and effective enforcement in place. However, as noted earlier, we may be approaching limits on the resources that society will commit to enforcing alcohol and driving laws. More importantly, effective alcohol interlock devices have an inherent advantage: It is far better to prevent someone from breaking the law — and perhaps killing or injuring someone in the process — than to arrest and convict someone after the fact. Punishing the few alcohol-impaired drivers that our limited police resources are able to catch cannot bring back the lives taken by the many more drivers who were undetected.

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