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Alcohol and Suicide in Colorado, 2011-2015: Analyses from the Colorado Violent Death Reporting System

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Background

Excessive alcohol use contributes to an estimated 1,633 deaths annually in Colorado, which is an average of almost five deaths each day.¹ These deaths include both chronic and acute exposures to alcohol, ranging from liver disease to alcohol-related injuries. One in seven of these deaths in Colorado are among working-age adults ages 20-64, and for each death due to excessive drinking among Coloradans, an individual's life is cut short by an average of 29 years.²

Binge drinking contributes to these adverse outcomes, accounting for over one-half of the alcohol-related deaths, two-thirds of the years of potential life lost, and three-quarters of the economic costs due to excessive drinking.³ Binge drinking is defined as having four or more drinks for a woman or five or more drinks for a man per occasion, which may bring a person's blood alcohol concentration (BAC) level to 0.08 g/dL.⁴ Having a BAC of 0.08 g/dL may be associated with impairment or loss of judgement, self-control, reasoning, memory, and muscle coordination.⁵

A portion of these alcohol-attributable deaths include deaths by suicide. Research has shown that excessive alcohol use is associated with increased suicide risk.⁶ Suicide continues to be a critical public health concern both nationally and in Colorado. In 2015, the age-adjusted suicide rate in Colorado was 19.0 suicides per 100,000 population,⁷ which is significantly higher than the national rate (13.3 per 100,000).⁸ Among suicide decedents in Colorado from 2011-2015 that had toxicological testing performed for at least one substance, more than one-third (35.8%) had alcohol in their system at the time of death, which was more than any other substance.⁷ Additionally, more than one-quarter (27.7%) of suicide decedents with at least one known circumstance had a problem with alcohol, which may include alcohol dependence (sometimes referred to as being addicted to alcohol).⁷

In order to better understand the relationship between suicide and alcohol use, this report will examine trends in BAC levels of those suicide decedents who were tested for alcohol post-mortem and had a known BAC, using data from the Colorado Violent Death Reporting System between 2011 and 2015.

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Methods

Data for this report were obtained from the Colorado Violent Death Reporting System (CoVDRS), which was first implemented at the Colorado Department of Public Health and Environment (CDPHE) in 2004. The CoVDRS is an enhanced public health surveillance system that captures data on all violent deaths occurring in Colorado. A violent death includes any death by suicide, homicide, unintentional firearm discharge, legal intervention, as well as selected deaths of undetermined intent when the death may have been the result of violence. Colorado is one of 42 states and territories currently participating in the broader National Violent Death Reporting System (NVDRS), which is maintained and funded by the Centers for Disease Control and Prevention (CDC). The NVDRS is the centralized database consisting of de-identified violent death data submitted by all participating states. A full description of the data collection processes of the NVDRS is provided elsewhere.⁹ The CoVDRS collects and inputs data from multiple sources including death certificates, coroner/medical examiner reports, and law enforcement investigations.

Data in this report include all Colorado suicide deaths of residents from 2011 to 2015 where toxicological testing was completed and reported to the CoVDRS. Deaths are identified as suicides for the CoVDRS based on either the indication as the manner of death on the death certificate or the presence of International Classification of Diseases, 10th Revision (ICD-10) coding for suicide as underlying cause of death (X60-X84 and Y87.0).¹⁰ Circumstances associated with death were obtained through information on the death certificates, coroner/medical examiner investigations and autopsy reports, and the law enforcement investigation reports. For the purposes of this report, suicide deaths that occurred in Colorado among non-Colorado residents and Colorado residents who died by suicide in other states were excluded. Additionally, decedents were excluded from the analysis if:

1. there was no toxicological information available;
2. no post-mortem toxicological testing was done; or
3. BAC was not known.

Decedents were categorized based on the BAC at the time of death. Decedents were categorized into two groups: BAC < 0.08 g/dL (including no alcohol present) and BAC ≥ 0.08 g/dL. Within these BAC categories, decedents were examined by age, sex, race/ethnicity, marital status, veteran status, county type (i.e. urban, rural/frontier), means of suicide, and associated precipitating circumstances. For this report, method of injury is reported as one of four possible categories: firearm, hanging/asphyxiation/suffocation, poisoning (including illicit and prescription drugs as well as carbon monoxide), and other (e.g. jumping from a high place and sharp objects).

Descriptive statistics were calculated for suicide decedents from 2011-2015 who were tested for alcohol and are presented as the number of cases for a given category and percent of the total number of deaths for a given category. Statistical significance between groups within a category was assessed using chi-square and Fisher's exact tests (when numbers of events were fewer than five). Differences are described as statistically significant if the p-value is < 0.05. Data were also reviewed to assess potential biases in alcohol testing by reviewing differences between those tested and not tested for alcohol based on several demographics and circumstance characteristics.

Results

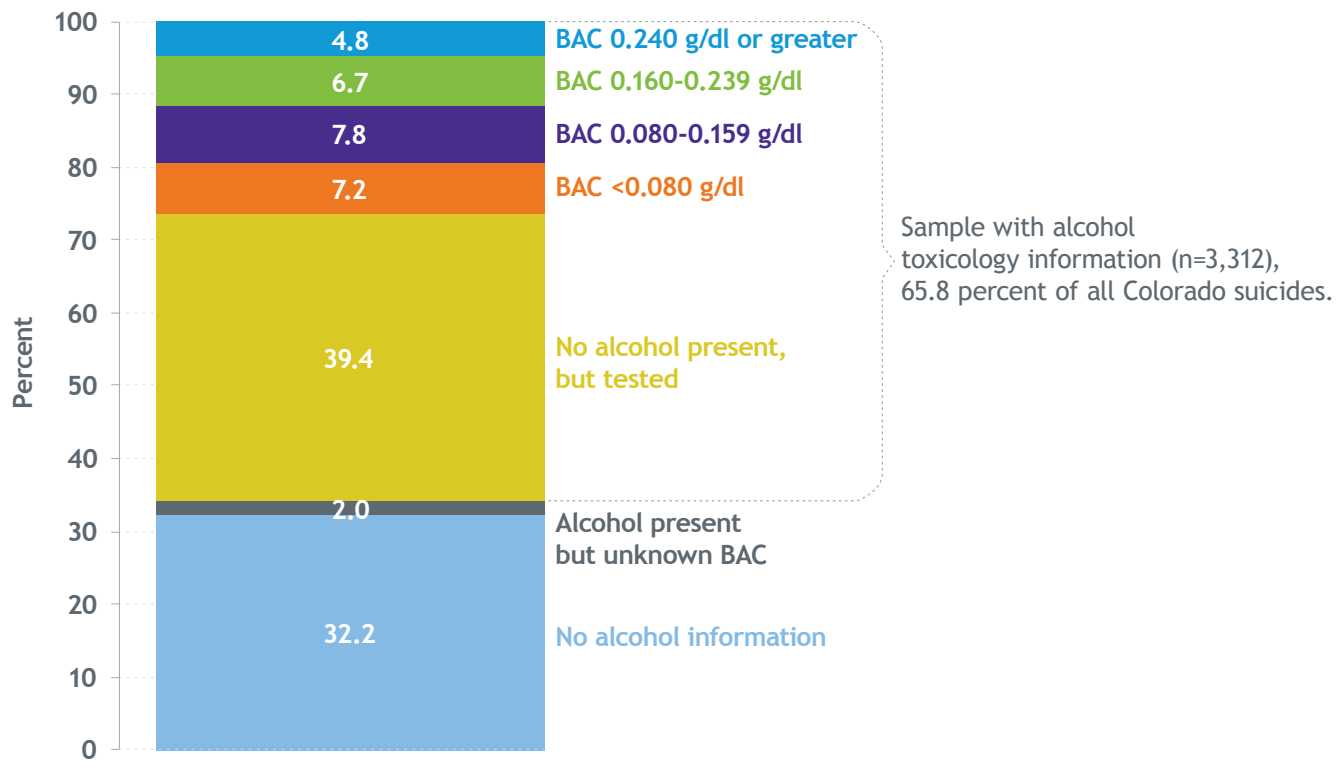
From 2011 to 2015, 67.8 percent (n=3,411) of all suicide decedents (n=5,030) had toxicological testing for the presence of alcohol. Among those suicide decedents who were tested for alcohol (n=3,411), 41.9 percent (n=1,428) had alcohol present. Two percent of all suicide deaths (n=99) had alcohol present with an unknown BAC, and these cases were excluded from the analysis (Table 1).

Table 1. Suicide deaths by alcohol testing and blood alcohol concentration results, Colorado residents, 2011-2015.

Alcohol Testing and BAC Results	n	Percent
Not tested for alcohol or no toxicology info obtained	1,619	32.2
Tested for alcohol, no alcohol present	1,983	39.4
Tested for alcohol, BAC < 0.08 g/dL	360	7.2
Tested for alcohol, BAC ≥ 0.08 g/dL	969	19.3
Tested for alcohol, alcohol present with unknown BAC	99	2.0
Total	5,030	100.0

Source: Colorado Violent Death Reporting System, 2011-2015.

Figure 1. Suicide deaths by alcohol testing and blood alcohol concentration results, Colorado residents, 2011-2015.



Source: Colorado Violent Death Reporting System, 2011-2015.

In the population with a known BAC (n=3,312), 70.7 percent (n=2,343) of suicide decedents had a BAC < 0.08 g/dL (including no alcohol present) and 29.3 percent (n=969) of suicide decedents had a BAC ≥ 0.08 g/dL (Table 2).

Table 2. Suicide deaths by blood alcohol concentration level in study population, Colorado residents, 2011-2015.

Alcohol Results	n	Percent
BAC < 0.08 g/dL (including no alcohol present)	2,343	70.7
BAC ≥ 0.08 g/dL	969	29.3
Total	3,312	100.0

Source: Colorado Violent Death Reporting System, 2011-2015.

Demographics

Statistically significant associations were found between BAC level and sex, age, race/ethnicity, marital status, veteran status, and method of suicide (Table 3). Suicide decedents with a BAC ≥ 0.08 g/dL were more likely to be male, a “working age” adult (ages 21-24, 25-34, 35-44, 45-54), Hispanic or American Indian/Alaskan Native, when compared to the BAC < 0.08 g/dL (including no alcohol present) group. Additionally, those with a BAC ≥ 0.08 g/dL were more likely to have died via firearm or hanging, to have been married or divorced, and to have been a non-Veteran compared to suicide decedents who had a BAC < 0.08 g/dL (including no alcohol present). No significant association was found between BAC level and county type (e.g. rural/frontier and urban).

Table 3. Frequencies, percentages, and chi-square statistical significance testing by blood alcohol concentration level for demographics of suicide decedents and method of suicide, Colorado residents occurrences, 2011-2015 (n=3,312).

Variable	Category	BAC < 0.08 g/dL or alcohol not present (n=2343)		BAC ≥ 0.08 g/dL (n=969)		Total suicide population (N=5030)	
		n	Percent	n	Percent	n	Percent
Overall		2,343	100.0	969	100.0	5,030	100.0
Sex	Male	1,758	75.0	765	78.9	3,855	76.6
	Female	585	25.0	204	21.1	1,175	23.4
Age (years)	10-20 yrs	254	10.8	30	3.1	383	7.6
	21-24	139	5.9	90	9.3	332	6.6
	25-34	345	14.7	233	24.0	844	16.8
	35-44	340	14.5	204	21.1	827	16.4
	45-54	474	20.2	234	24.1	1,057	21.0
	55-64	419	17.9	131	13.5	859	17.1
	65+	372	15.9	47	4.9	728	14.5
Race/Ethnicity	White, non-Hispanic	2,001	85.4	809	83.5	4,221	83.9
	White, Hispanic	227	9.7	120	12.4	549	10.9
	Black or African American	52	2.2	17	1.8	117	2.3
	Asian, Native Hawaiian or Pacific Islander	43	1.8	8	0.8	88	1.7
	American Indian or Alaskan Native	18	0.8	15	1.5	55	1.1
County type	Rural/Frontier	321	13.7	146	15.1	765	15.2
	Urban	2,020	86.2	822	84.8	4,265	84.8
Marital status	Currently married	841	35.9	369	38.1	1,795	35.7
	Divorced	514	21.9	222	22.9	1,179	23.4
	Never married	847	36.2	344	35.5	1,775	35.3
	Widowed	126	5.4	28	2.9	254	5.0
Veteran status	Non-veteran	1,912	81.6	819	84.5	4,098	81.5
	Veteran	427	18.2	146	15.1	922	18.3
Method of Injury	Firearm	1,078	46.0	515	53.1	2,468	49.1
	Hanging	551	23.5	250	25.8	1,258	25.0
	Other	149	6.4	53	5.5	311	6.2
	Poisoning	565	24.1	151	15.6	993	19.7

Source: Colorado Violent Death Reporting System, 2011-2015.

Shading indicates the distribution of the specified characteristic is statistically significantly different for each group defined by the BAC level, statistically significant at an alpha = 0.05.

Circumstances

Table 4 outlines circumstances most frequently reported with suicide deaths where suicide decedents had a BAC ≥ 0.08 g/dL. The most frequent circumstance reported was having a 'problem with alcohol' (61.4%), referring to a decedent that was perceived by self or others to have had a problem with alcohol or to be alcohol dependent. The second most frequent circumstance noted was current depressed mood (56.8%), which is an indication by family, friends, or acquaintances that the victim was exhibiting a depressed mood (including being noted as feeling sad or despondent) close to the date/time of death. In addition, more than half of suicides among those with a BAC ≥ 0.08 g/dL had a known intimate partner problem (50.6%) which was noted as contributing to their suicide.

The circumstances that had statistically significant associations with BAC level are also outlined in Table 4. For example, 50.6 percent of those suicide decedents with a BAC ≥ 0.08 g/dL had an intimate partner problem compared to 32.3 percent of suicide decedents with a BAC < 0.08 g/dL. This suggests that alcohol may play a more significant role in suicide deaths where there were also intimate partner circumstances. Additional circumstances that had significant associations with BAC level and where the proportion is higher in the BAC ≥ 0.08 g/dL category include those where the decedent had a problem with alcohol, disclosed suicidal intent, an argument preceding the death, and a job problem.

Table 4. Frequencies, percentages, and chi-square statistical significance testing by BAC level for circumstances, Colorado residents, 2011-2015.

Circumstances	BAC < 0.08 g/dL or alcohol not present		BAC ≥ 0.08 g/dL		Total suicide population	
	N	Percent of suicides with known circumstance*	N	Percent of suicides with known circumstance*	N	Percent of suicides with known circumstance*
Suicides with 1+ known circumstance	2,208	94.2	911	94.0	4,576	91.0
Problem with alcohol**	361	16.4	559	61.4	1,269	27.7
Current depressed mood	1,273	57.7	517	56.8	2,552	55.8
Intimate partner problem**	713	32.3	461	50.6	1,599	34.9
Current mental health problem	1,119	50.7	416	45.7	2,248	49.1
Ever treated for mental health problem	912	41.3	331	36.3	1,831	40.0
Diagnosis of depression	820	37.1	328	36.0	1,672	36.5
Disclosed suicidal intent**	690	31.3	320	35.1	1,426	31.2
Death preceded by argument**	442	20.0	319	35.0	1,050	23.0
History of suicidal thoughts or plans**	670	30.3	297	32.6	1,330	29.1
Crisis in last two weeks**	623	28.2	271	29.8	1,254	27.4
History of previous suicide attempts	624	28.3	254	27.9	1,255	27.4
Left a suicide note	852	38.6	236	25.9	1,670	36.5
Current mental health treatment	714	32.3	233	25.6	2,248	49.1
Physical health problem	792	35.9	200	22.0	1,495	32.7
Job problem**	390	17.7	199	21.8	835	18.3
Problem with other substance**	420	19.0	187	20.5	798	17.4
Contributing criminal legal problem**	366	16.6	163	17.9	735	16.1
Family relationship problem	381	17.3	149	16.4	714	15.6
Financial problem	359	16.3	141	15.5	721	15.8

Source: Colorado Violent Death Reporting System, 2011-2015.

*Percentage of total cases with at least one circumstance is known (193 cases in the study population have no known circumstances: 135 cases with a BAC < 0.08 g/dL (including no alcohol present) and 58 cases with a BAC ≥ 0.08 g/dL).

**Indicates that the percentage within a circumstance (e.g. job problem) is higher within the BAC ≥ 0.08 g/dL category compared to the BAC < 0.08 g/dL (including no alcohol present).

Shading Indicates that the comparison between the specified circumstance and BAC level is statistically significant at an alpha = 0.05.

Please note: A suicide decedent with more than one documented circumstance will be counted in each individual category.

Discussion

More than a quarter of suicide decedents tested for alcohol (29.3%) had a BAC ≥ 0.08 g/dL, a level that may impair judgment, self-control, reasoning and the ability to detect danger.⁵ At least half of these alcohol-impaired suicide decedents were also dealing with alcohol problems in general (61.4%), depressed mood (56.8%) or problems with an intimate partner (50.6%). This analysis also found that the majority of decedents with a BAC ≥ 0.08 g/dL (53.1%) used a firearm as the method of suicide.

Excessive alcohol use, including binge drinking, is a cross-cutting risk factor for a number of outcomes related to injury and violence, including suicide. Estimates from the 2016 Colorado Behavioral Risk Factor Surveillance Survey (BRFSS), a representative, population-based survey, show that one in five adults binge drink about four times per month consuming about seven drinks per binge.¹¹ According to the 2016 Colorado BRFSS, men, working age adults (18-44 years old), and Hispanic and White adults reported a significantly higher prevalence of binge drinking compared to other groups.¹¹ In many ways, these population-level estimates mirror results from this report where suicide decedents with BAC ≥ 0.08 g/dL are more likely to be male, working age (21-54 years), and Hispanic or American Indian/Alaskan Native than suicide decedents with BAC < 0.08 g/dL. Additionally, White, non-Hispanic individuals make up 83.5 percent of suicide deaths with a BAC ≥ 0.08 g/dL. This similarity between the population demographics that binge drink and those that die by suicide with a BAC ≥ 0.08 g/dL suggests that evidence-based population-level approaches for reducing excessive drinking may also reduce suicide deaths.

A number of limitations require careful consideration when interpreting these data. As noted in the methods, BAC was only assessed for those suicide decedents who had toxicological testing for the presence of alcohol and had a known BAC. Statistically significant differences were observed between those who were tested and not tested for alcohol for a number of demographic characteristics and circumstances involved in the death. These include characteristics like such as age, race/ethnicity, method of suicide, marital status, county size, and alcohol use suspected at the time of injury. Toxicological testing by death investigators can be costly and may be conducted sparingly due to scarce resources and strict budgets.

These observed differences indicate that testing for alcohol varies across groups of people, which could bias the data provided in this report. For example, youth are more likely to be tested for alcohol upon death by suicide, yet less likely to have alcohol present in toxicology screenings. Additionally, data quality may vary due to differential toxicology testing based on Colorado's coroner system and the various law enforcement agencies that provide information to the CoVDRS. Further, while a BAC ≥ 0.08 g/dL is commonly used as a threshold for assessing impairment (such as for alcohol-impaired driving), individual effects of alcohol may vary based on factors such as age, sex, race or ethnicity, a person's physical condition (weight and fitness level), and the amount of food consumed before drinking.¹²

Research indicates that population-level alcohol prevention strategies, including stronger alcohol policies, could be effective at preventing alcohol-involved suicide deaths. One review of the published literature on the effects of alcohol policies on suicide deaths indicated that stronger alcohol policies may reduce suicide and decrease the level of alcohol involvement among suicide decedents.¹³ Effective alcohol policies to reduce excessive alcohol use may include the regulation of alcohol outlet density, increasing alcohol taxes, maintaining limits on days or hours of alcohol sales, or commercial host liability laws.¹⁴

The results in this report highlight the value of increased collaboration between suicide prevention, substance use prevention and treatment, and public health professionals at both the state and local levels. Overall, 27.7 percent of all suicide deaths among Colorado residents occurring in Colorado from 2011-2015 had known alcohol problems, and alcohol problems were twice as common among the alcohol-impaired suicide deaths. Specifically, 64.1 percent of the suicide decedents with a BAC ≥ 0.08 g/dL were known to have alcohol problems in general, in addition to the elevated BAC at the time of death. Therefore, a more complete understanding of the role of alcohol as a risk factor in suicide deaths will support communities in developing comprehensive suicide prevention programs that address excessive drinking prevention as well.

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Works Cited

1. Alcohol and Public Health: Alcohol-Related Disease Impact (ARDI). (n.d.). Retrieved from www.cdc.gov/ardi
2. Stahre, M., Roeber, J., Kanny, D., Brewer, R. D., & Zhang, X. (2014). Contribution of Excessive Alcohol Consumption to Deaths and Years of Potential Life Lost in the United States. *Preventing Chronic Disease*,11. doi:10.5888/pcd11.130293
3. Vital Signs: Binge Drinking Prevalence, Frequency and Intensity Among Adults–United States, 2010. Centers for Disease Control and Prevention. January 13, 2012 / 61(01);14-19
4. National Institute of Alcohol Abuse and Alcoholism. NIAAA council approves definition of binge drinking. NIAAA Newsletter. 2004;3:3. Retrieved from <https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking>
5. Typical Effects based on Blood Alcohol Concentration (BAC). Centers for Disease Control and Prevention. Retrieved from <https://www.cdc.gov/motorvehiclesafety/pdf/bac-a.pdf>
6. CDC. Fact Sheets - Alcohol Use and Your Health. (2018, January 03). Retrieved from <https://www.cdc.gov/alcohol/fact-sheets/alcohol-use.htm>
7. Jamison, E., Mintz, S., Herndon, K., Bol, K. (2017). et al. Suicide in Colorado, 2011-2015: A Summary from the Colorado Violent Death Reporting System. Colorado Department of Public Health and Environment Health Watch, No. 102
8. CDC WONDER (Wide-ranging Online Data for Epidemiologic Research). Center for Disease Control and Prevention. Retrieved from <https://wonder.cdc.gov/> on September 11th, 2017
9. National Violent Death Reporting System, Division of Violence Prevention, Centers for Disease Control and Prevention. (2017, September 18). Retrieved from <http://www.cdc.gov/violenceprevention/nvdrs/>
10. International Statistical Classification of Diseases and Related Health Problems 10th Revision. Retrieved from <http://apps.who.int/classifications/icd10/browse/2010/en#/>
11. Colorado Behavioral Risk Factor Surveillance System, 2016. Colorado Department of Public Health and Environment
12. Alcohol and Public Health - Frequently Asked Questions. (2018, March 29). Retrieved from <https://www.cdc.gov/alcohol/faqs.htm>
13. Xuan, Z., Naimi, T. S., Kaplan, M. S., Bagge, C. L., Few, L. R., Maisto, S., . . . Freeman, R. (2016). Alcohol Policies and Suicide: A Review of the Literature. *Alcoholism: Clinical and Experimental Research*,40(10), 2043-2055. doi:10.1111/acer.13203
14. Fact Sheets - Preventing Excessive Alcohol Use. (2016, October 17). Retrieved from <https://www.cdc.gov/alcohol/fact-sheets/prevention.htm>