

## The Association between Toxicology and Suicide Notes among Firearm Suicide Decedents, 2004-2015:

### An Analysis from the Colorado Violent Death Reporting System

*Prepared by:*

Jewell Johnson, MPH,<sup>1</sup> Ethan Jamison, MPH,<sup>2</sup> Kirk Bol, MSPH<sup>2</sup>

1. Violence and Injury Prevention-Mental Health Promotion Branch, Prevention Services Division, Colorado Department of Public Health and Environment.
2. Vital Statistics and Registries Branch, Center for Health and Environmental Data, Colorado Department of Public Health and Environment.

---

#### Introduction

Suicide continues to be an increasing public health problem in Colorado, nationally, and globally. According to current literature, both acute intoxication and chronic substance use can contribute to suicidal behavior<sup>1</sup> and alcohol and drug abuse have been identified as one of the most common risk factors for suicidal behavior.<sup>2</sup> Consequently, individuals who suffer from alcohol dependency are ten times more likely to die by suicide and those who inject drugs are fourteen times more likely to die by suicide, compared to the general population.<sup>1</sup> Furthermore, research also suggests that there is a strong bidirectional relationship between impulsivity and substance use<sup>3</sup> where substance use increases impulsivity and impulsivity increases substance use.

Suicide notes are also a key element in understanding what factors influenced a person's suicidality, as well as informing the death investigation process.<sup>4</sup> Suicide notes can be considered an unstructured and unsolicited form of communication between the decedent and the surviving family and friends.<sup>5</sup> Suicide notes can take on many forms including a traditional physical note, or an electronic form including email, text message, voice message, or video.<sup>6</sup> Clinically, in non-fatal suicide attempts, the presence of a suicide note can be used to assess the level of premeditation of the attempt.<sup>7</sup> Furthermore, when suicide notes are examined in the chain of events between suicidal ideation and suicide death, it logically follows that it takes some planning to leave a suicide note.

When examining suicide research, opinions vary as to the significance of suicide notes<sup>5</sup> and whether there are differences between those who leave notes and those who don't.<sup>6-9</sup> Based on the clinical importance of notes in suicide attempts, the absence of a suicide note may serve as a proxy measure to indicate the suicide was less planned, and more of a spontaneous or impulsive act. Some research suggests that a large portion of suicides were the result of an impulsive act rather than a history of suicidal thought and premeditation.<sup>10</sup> It is important to note that suicidal thoughts and ideation can be chronic, acute or even situational.<sup>11</sup> Method used to inflict the fatal injury is also relevant when discussing impulsive suicides. Firearms continue to be the leading method of suicide: In

Colorado 49.2 percent (n=5,267) of suicides were completed with a firearm between 2004 and 2015.<sup>12</sup> The research has shown that firearms are the most lethal method of suicide attempt,<sup>13</sup> and few survive an attempt.

In the body of research on impulsive suicide, few studies have investigated the association between the absence of suicide notes and the odds of having one or more substances present in the body at the time of death, specifically among suicide decedents who used a firearm. The purpose of this study was to investigate the association of not leaving a suicide note for individuals who had a positive toxicology for specific substances of interest at the time of death among all individuals who died by suicide with a firearm in Colorado.

## Methods

Using data from the Colorado Violent Death Reporting System, (CoVDRS) a case control study, was conducted to investigate the association between not leaving a suicide note and having specific substances present in the body at the time of death among firearm suicide decedents in Colorado. The CoVDRS is part of the larger National Violent Death Reporting System (NVDRS), an enhanced public health surveillance system, created and funded by the U.S. Centers for Disease Control and Prevention (CDC). This present study explores firearm suicides only, specifically for the interplay between impulsive suicidal behavior and the lethality of firearms. Suicide decedents who fatally injured themselves with other methods, or who had missing toxicological, circumstance, or demographic information were not included in this study.

The study population was made up of firearm suicide decedents that resided in the state of Colorado, and who died in Colorado between 2005 and 2015. The exposure of interest for this study was defined as the toxicological presence of specific substances in the body at the time of death. The specific substances included the categories of alcohol, opiates, benzodiazepines, cocaine, marijuana, and amphetamines. These categories were defined via the NVDRS coding manual.<sup>14</sup> The outcome of interest was whether or not the suicide decedent left a suicide note.

Cases for this study were defined as all firearm suicide decedents who did not leave a suicide note. Controls for this study were defined as all firearm suicide decedents who did leave a suicide note. Specific demographic information such as age, race, gender, veteran status, residential county type, and whether an argument preceded death, were analyzed for confounding. Additionally, gender and whether argument preceded death were evaluated as possible effect modifiers.

Age was stratified into five groups (10-24, 25-39, 40-54, 55-69, and 70 years and older). For purposes of this study, race was categorized into four groups, Non-Hispanic White, Hispanic White, Black/African American, and other (representing Asian/Pacific Islanders and American Indian/Native Alaskans). Marital status was categorized into four groups: Currently married, divorced, never married, or widowed. Residential county was classified as urban or rural, based on definitions from the Colorado Rural Health Center.<sup>15</sup>

The statistical analysis included chi square tests, odds ratios, and purposeful logistic regression modeling to evaluate the association between not leaving a suicide note and having one of the specific substances present in the body at the time of death. Each substance was analyzed independently, which constituted six different models, where the reference category being the absence of that specific substance. Results were determined to be statistically significant by an alpha level of 0.05.

## Results

The final sample size included 3,688 firearm suicide decedents in Colorado, with 64 percent of decedents not leaving a suicide note. Demographic information such as age, gender, race, marital status, and residential county type were significantly associated with not leaving a suicide note. Substances of interest that were statistically significant suggest that there is an association of not leaving a suicide note among individuals who had alcohol, marijuana, or amphetamines present in the body at the time of death. Table 1 displays the counts, percentages, and chi square p-values for suicide decedents by the presence or absence of a suicide note.

**Table 1. Suicide decedents by suicide note: counts, percentages and chi square p-values (2005-2015).**

Variable	Suicide note present		P-value
	No (%)	Yes (%)	
<b>Total sample size N=3,688</b>			
	2,345 (63.58)	1,343 (36.42)	
<b>Gender</b>			<0.0001
Male	2,081 (88.74)	1,124 (83.69)	
Female	264 (11.26)	219 (16.31)	
<b>Age</b>			0.0028
10-24	339 (14.45)	165 (12.29)	
25-39	554 (23.62)	268 (19.96)	
40-54	677 (28.87)	400 (29.78)	
55-69	471 (20.09)	329 (24.50)	
70+	304 (12.96)	181 (13.48)	
<b>Race</b>			<0.0001
Non-Hispanic White	2,026 (86.39)	1,229 (91.51)	
Hispanic White	212 (9.04)	68 (5.06)	
Black / African American	60 (2.56)	22 (1.63)	
Other	47 (2.00)	24 (1.79)	
<b>Marital status</b>			0.0003
Currently married	1,018 (43.41)	515 (38.35)	
Divorced	452 (19.27)	332 (24.72)	
Never married	744 (31.73)	410 (30.53)	
Widowed	131 (5.58)	86 (6.40)	
<b>Ever served in U.S. military</b>			0.4755
No	1,682 (71.72)	978 (72.82)	
Yes	663 (28.27)	365 (27.18)	
<b>Residential county type</b>			0.0027
Rural	373 (12.45)	165 (12.29)	
Urban	1,972 (84.09)	1,178 (87.71)	
<b>Argument preceded death</b>			<0.0001
Yes	531 (22.64)	177 (13.18)	
No	1,814 (77.35)	1,166 (86.82)	
<b>Alcohol present</b>			<0.0001
Yes	946 (40.34)	391 (29.11)	
No	1,399 (59.66)	952 (70.89)	

Variable	Suicide note present		P-value
	No (%)	Yes (%)	
<b>Benzodiazepines present</b>			0.2367
Yes	116 (4.95)	55 (4.09)	
No	2,229 (95.13)	1,288 (95.90)	
<b>Marijuana present</b>			0.0183
Yes	254 (10.83)	113 (8.41)	
No	2,091 (89.16)	1,230 (91.58)	
<b>Cocaine present</b>			0.5456
Yes	71 (3.03)	36 (2.68)	
No	2,274 (96.97)	1,307 (97.31)	
<b>Amphetamines present</b>			0.0089
Yes	94 (4.01)	32 (2.38)	
No	2,251 (95.99)	1,311 (97.61)	
<b>Opiates present</b>			0.9578
Yes	230 (9.81)	131 (9.75)	
No	2,115 (90.19)	1,212 (90.25)	

Table 2 below presents the crude odds ratios, and p-values for the association of not leaving a suicide note. Those who had alcohol, marijuana, or amphetamines present in the body at the time of death were statistically more likely to not leave a suicide note compared to those who did not have those substances present in the body at the time of death, (alcohol 1.65 (95% CI: 1.43 -1.90), marijuana 1.32 (95% CI: 1.05- 1.67), amphetamine 1.71 (95% CI: 1.14- 2.57). Furthermore, decedents who were between the ages of 25 and 39, who were identified as Hispanic White or Black/African American, male, divorced, or living in a rural county, were more likely not to leave a suicide note.

Table 2. Crude odds ratios\* and chi square p-values for suicide decedents who did not leave a suicide note (2005-2015).

Variable	Unadjusted odds ratio	P-value
<b>Substances</b>		
Alcohol present	1.65	<.0001
Alcohol not present	1.00*	
Benzodiazepines present	1.22	0.2374
Benzodiazepines not present	1.00*	
Marijuana present	1.32	0.0186
Marijuana not present	1.00*	
Cocaine present	1.13	0.5458
Cocaine not present	1.00*	
Amphetamines present	1.71	0.0097
Amphetamines not present	1.00*	
Opiates present	1.01	0.9578
Opiates not present	1.00*	
<b>Gender</b>		
Male	1.54	<0.0001
Female	1.00*	

Variable	Unadjusted odds ratio	P-value
<b>Age</b>		
10-24 years	1.21	0.089
25-39 years	1.22	0.0403
40-54 years	1.00*	
55-69 years	0.85	0.0799
70+ years	0.99	0.9459
<b>Race</b>		
Non-Hispanic White	1.00*	
Hispanic White	1.89	<.0001
Black / African American	1.65	0.0456
Other	1.19	0.4968
<b>Marital status</b>		
Currently married	1.09	0.2962
Divorced	0.75	0.0025
Widowed	0.84	0.2489
Never married	1.00*	
<b>Ever served in U.S. military</b>		
Veteran	1.06	0.477
Non-veteran	1.00*	
<b>Residential county type</b>		
Rural and frontier	1.35	0.0028
Urban	1.00*	
<b>Argument preceded death</b>		
Yes	1.93	<.0001
No	1.00*	

\* Represents the referent/comparison group for odds ratio calculation

Table 3 below displays the adjusted odds ratios, 95 percent confidence intervals and p-values for suicide decedents who had substances present in the body at the time of death and did not leave a suicide note. After adjusting for gender, race, marital status, residential county type, and whether an argument preceded death, those who had alcohol or amphetamines present in the body at the time of death were at 1.57 (95% CI: 1.36-1.82) and 1.71 (95% CI: 1.13-2.58) greater odds of not leaving a suicide note compared to those who did not have alcohol or amphetamines present, respectively.

**Table 3. Adjusted\* odds ratios, 95 percent confidence intervals and p-values for suicide decedents who did not leave a suicide note by specific substance present.**

Covariates	Alcohol		Benzodiazepines		Cocaine		Marijuana		Amphetamines		Opiates	
	Adjusted OR	P-value	Adjusted OR	P-value	Adjusted OR	P-value	Adjusted OR	P-value	Adjusted OR	P-value	Adjusted OR	P-value
	(95% CI)		(95% CI)		(95% CI)		(95% CI)		(95% CI)		(95% CI)	
<b>Specific substance present</b>												
Present	1.57 (1.36, 1.82)	<.0001	1.28 (0.92,1.79)	0.1497	1.11 (0.73,1.68)	0.6402	1.24 (0.98,1.57)	0.0798	1.71 (1.13, 2.58)	0.0112	1.07 (0.85,1.34)	0.5739
Not present	1.00**		1.00**		1.00**		1.00**		1.00**		1.00**	

Covariates	Alcohol		Benzodiazepines		Cocaine		Marijuana		Amphetamines		Opiates	
	Adjusted OR	P-value										
	(95% CI)		(95% CI)		(95% CI)		(95% CI)		(95% CI)		(95% CI)	
<b>Gender</b>												
Male	1.55 (1.28, 1.89)	<.0001	1.57 (1.29,1.91)	<.0001	1.56 (1.28,1.90)	<.0001	1.55 (1.27, 1.89)	<.0001	1.57 (1.29,1.91)	<.0001	1.56 (1.28,1.90)	<.0001
Female	1.00**		1.00**		1.00**		1.00**		1.00**		1.00**	
<b>Race</b>												
Non-Hispanic White	1.00**		1.00**		1.00**		1.00**		1.00**		1.00**	
Hispanic White	1.85 (1.39, 2.47)	<.0001	1.86 (1.40,2.48)	<.0001	1.85 (1.39, 2.46)	<.0001	1.84 (1.38, 2.45)	<.0001	1.80 (1.35,2.40)	<.0001	1.86 (1.39, 2.47)	<.0001
Black / African American	1.65 (0.99, 2.75)		0.0514		1.65 (0.99, 2.73)		0.0506		1.63 (0.99, 2.70)		0.0568	
Other	1.16 (0.70, 1.92)	0.5575	1.19 (0.72, 1.97)	0.4885	1.18 (0.71, 1.95)	0.5237	1.18 (0.71, 1.94)	0.5298	1.17 (0.71, 1.94)	0.5348	1.18 (0.72, 1.95)	0.5132
<b>Marital status</b>												
Currently married	1.13 (0.96, 1.34)	0.1415	1.10 (0.93, 1.29)	0.2767	1.10 (0.94, 1.30)	0.2471	1.11 (0.95, 1.31)	0.2	1.11 (0.94, 1.31)	0.2034	1.10 (0.93, 1.29)	0.2692
Divorced	0.82 (0.68, 0.99)		0.0391		0.81 (0.67, 0.98)		0.0333		0.81 (0.67, 0.98)		0.0328	
Never married	1.00**		1.00**		1.00**		1.00**		1.00**		1.00**	
Widowed	1.03 (0.76, 1.39)	0.868	0.96 (0.71, 1.3)	0.792	0.96 (0.71, 1.30)	0.7858	0.98 (0.72, 1.32)	0.8881	0.97 (0.72, 1.32)	0.8637	0.96 (0.71, 1.29)	0.7709
<b>Residential county type</b>												
Rural and frontier	1.39 (1.13, 1.69)	0.0015	1.40 (1.14, 1.71)	0.0011	1.39 (1.14, 1.70)	0.0011	1.40 (1.14, 1.71)	0.001	1.40 (1.14,1.71)	0.0011	1.40 (1.14, 1.71)	0.0011
Urban	1.00**		1.00**		1.00**		1.00**		1.00**		1.00**	
<b>Argument preceded death</b>												
Yes	1.78 (1.47, 2.15)	<.0001	1.88 (1.56, 2.27)	<.0001	1.88 (1.56, 2.28)	<.0001	1.87 (1.55, 2.26)	<.0001	1.89 (1.57,2.28)	<.0001	1.89 (1.56, 2.28)	<.0001
No	1.00**		1.00**		1.00**		1.00**		1.00**		1.00**	

\*After adjusting for gender, marital status, urban vs. rural residential status, and argument preceding death; The covariates age and veteran status did not contribute statistically significantly to each model and was therefore removed.

\*\* Represents the referent/comparison group for odds ratio calculation.

## Discussion

After controlling for demographic factors, those who had alcohol or amphetamines present in the body at the time of death were more likely not to leave a suicide note compared to those that did not have alcohol or amphetamines present in the body at the time of death. The results also show that certain demographic information such as being Hispanic White, divorced, male, or living in a rural county increases the odds of not leaving a suicide note. Additionally, when a decedent had an argument precede their death, they were statistically less likely to leave a note. These results may highlight a specific portion of crisis-related suicide deaths, where a note was never left.

Research has shown alcohol-dependent users have higher rates of past suicide attempts, with the majority being impulsive acts.<sup>16</sup> Additionally substance use was found to be associated with short decision time prior to an attempt, as well.<sup>10</sup> The results from this study align closely these findings in that those with alcohol or amphetamines present were more likely to not leave a note, perhaps indicating a more impulsive suicide. It is therefore important for suicide prevention efforts/purposes to consider the lethality of an impulsive suicide attempt via firearm. Therefore, in order to strive to prevent these deaths, prevention programs should consider access to lethal means among their strategies for supporting those at risk during a time of crisis or, more pointedly, a time of increased substance use.

Additionally, these data touch on some of the cross-cutting risk factors between suicide and substance abuse. Although those who have entered substance abuse treatment often report past suicide attempts<sup>17</sup> there still exists an underlying gap in treatment because it has been reported that some substance abuse treatment programs will not accept individuals who have reported recent suicidal behavior.<sup>1</sup> Therefore, there may be room to improve gaps in care by integrating suicide prevention at substance abuse treatment centers for those suffering from acute and chronic substance use issues.

An important distinction about this study was that there was no way to determine the temporality of substance use and leaving a suicide note. Particularly among suicide decedents who left a suicide note and had substances present in the body at the time of death, they could have written or created the suicide note before ingesting the substance. In addition to temporality, this study did not examine the concentrations of each substance in the blood. Having a higher concentration in the blood could potentially have a greater impact on impulsive suicidal behavior. Furthermore, the data could not decipher between illicit and prescription drugs. A suicide decedent could have had a positive toxicology for amphetamines but it is unclear whether the decedent had a prescription such as Adderall or the illicit drug methamphetamine present in the body at the time of death. Lastly, the specific substances of interest that were included in the analyses were not mutually exclusive; therefore there was potential for further confounding by the presence of other substances.

The findings from this study are meant to better inform the relationship between substance use, impulsivity and suicide. Specifically these data speak to the need for robust safety planning in times of crisis for individuals who suffer from substance use disorders. The findings from this study can help agencies who develop suicide prevention programs, ranging from state and local health departments, crisis centers/crisis response teams, and substance abuse treatment centers.

## Acknowledgements

The authors would like to thank the Colorado Office of Suicide Prevention, the Colorado Suicide Prevention Commission, the Colorado Violent Death Reporting System Advisory Leadership Team, and members of its Advisory Network for their past and ongoing support and guidance of CoVDRS efforts. The Advisory Leadership Team is comprised of staff from the Violence and Injury Prevention - Mental Health Promotion Branch and Children, Youth and Families Branch at CDPHE, as well as local, prevention, coroner, and law enforcement partners.

This report was supported by Cooperative Agreement Number NU58DP001006 and Cooperative Agreement Number 5NU17CE002593-04 from The Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.

## References

1. Yuodelis-Flores, C., & Ries, R. K. (2015). Addiction and suicide: A review. *American Journal on Addictions*, 24(2), 98-104. doi:10.1111/ajad.12185
2. Carretta, Burgess, & Welner. (2015). Gaps in Crisis Mental Health: Suicide and Homicide-Suicide. *Archives of Psychiatric Nursing*, 29(5), 339-345.
3. Kaiser, A., Bonsu, J. A., Charnigo, R. J., Milich, R., & Lynam, D. R. (2016). Impulsive personality and alcohol use: bidirectional relations over one year. *Journal of studies on alcohol and drugs*, 77(3), 473-482.
4. Koehler, S. A. (2007). The role of suicide notes in death investigation. *Journal of forensic nursing*, 3(2), 87-89.
5. Olson L.M., Wahab, S, Thompson, C. (2011). Suicide Notes Among Native American, Hispanic, and Anglos. *Qualitative Health Research*. 21(2), 1484-1494.
6. Cerel, J. Moore, M. Van de Venne, J. Brown, S.L. (2014). Who Leaves Suicide Notes? A Six-Year Population-Based Study. *Suicide and Life Threatening Behavior*.45(3). 326-334.
7. Salib, E., Cawley, S., & Healy, R. (2002). The significance of suicide notes in the elderly. *Aging & mental health*, 6(2), 186-190.
8. Carpenter, B., Bond, C., Tait, G., Wilson, M., & White, K. (2016). Who leaves suicide notes? An exploration of victim characteristics and suicide method of completed suicides in Queensland. *Archives of suicide research*, 20(2), 176-190.
9. Callanan, V. J., & Davis, M. S. (2009). A comparison of suicide note writers with suicides who did not leave notes. *Suicide and Life-Threatening Behavior*, 39(5), 558-568.
10. Rimkeviciene, J., & De Leo, D. (2015). Impulsive suicide attempts: a systematic literature review of definitions, characteristics and risk factors. *Journal of affective disorders*, 171, 93-104.
11. Nock, M.K. et al. (2008). Cross-national prevalence and risk factors for suicidal ideation, plans, and attempts. *British Journal of Psychiatry*. 192(2) 98-105
12. Colorado Violent Death Reporting System [Online]. (n.d.). Colorado Department of Public Health and Environment. Retrieved from <https://cohealthviz.dphe.state.co.us/t/OPPIPublic/views/CoVDRSSuicideData/Story1?%3Aembed=y>
13. Vyrostek, S. B., Annett, J. L., & Ryan, G. W. (2004). Surveillance for fatal and nonfatal injuries—United States, 2001. *MMWR Surveill Summ*, 53(7), 1-57.
14. Centers for Disease Control and Prevention. National Violent Death Reporting System (NVDRS) Coding Manual Revised [Online] (2015) National Center for Injury Prevention and Control, Centers for Disease Control and Prevention (producer). Available from URL: [www.cdc.gov/injury](http://www.cdc.gov/injury)
15. Colorado Rural Health Center. (2018). Snapshot of Rural Health in Colorado. Retrieved from <http://coruralhealth.wpengine.netdna-cdn.com/wp-content/uploads/2013/10/2018-Snapshot-FINAL-February-2018.pdf>
16. Czyz, E., Bohnert, A., King, C., Price, A., Kleinberg, F., & Ilgen, M. (2014). Self-efficacy to avoid suicidal action: Factor structure and convergent validity among adults in substance use disorder treatment. *Suicide and Life-threatening Behavior*, 44(6), 698-709.
17. Wojnar, M., Ilgen, M. A., Czyz, E., Strobbe, S., Klimkiewicz, A., Jakubczyk, A., ... & Brower, K. J. (2009). Impulsive and non-impulsive suicide attempts in patients treated for alcohol dependence. *Journal of affective disorders*, 115(1), 131-139.