

Suicide Categories by Patterns of Known Risk Factors

A Latent Class Analysis

Joseph Logan, PhD; Jeffrey Hall, PhD; Debra Karch, PhD

Context: Multiple risk factors contribute to suicides; however, patterns of co-occurrence among these factors have not been fully identified.

Objectives: To assess patterns of known suicide-related risk factors, classify suicide decedents by these patterns, track class proportions during a 6-year period, and characterize decedents across the classes to help focus prevention strategies.

Design, Setting, and Participants: Latent class analysis was conducted using 2003-2008 data from the National Violent Death Reporting System. The population included 28 703 suicide decedents from 12 US states.

Main Outcome Measures: The known risk factors included having the following: mental health conditions; a sad or depressed mood; substance abuse problems; medical problems; recent crises; financial, job, and legal problems; intimate partner and other relationship problems; and perpetrated interpersonal violence.

Results: Nine distinct patterns of risk factors emerged. Of these classes, 1 only endorsed mental health-related

factors and 1 only endorsed alcohol- and substance abuse-related factors; however, 7 classes of decedents had distinct patterns of factors that spanned multiple domains. For example, 5 of these classes had mental health factors with other risks (eg, substance abuse, financial problems, relationship problems, a recent crisis, and medical problems). Two classes had recent crises with relationship problems; one of these classes also had high probabilities for criminal problems and interpersonal violence. Class proportions differed during the 6 years. Differences across classes by demographic and event characteristics were also found.

Conclusions: Most suicide decedents could be classified by patterns of risk factors. Furthermore, most classes revealed a need for more connected services across medical, mental health/substance abuse, and court/social service systems. Reducing fragmentation across these agencies and recruiting family, friend, and community support for individuals experiencing mental health problems and/or other stress might significantly reduce suicides.

Arch Gen Psychiatry. 2011;68(9):935-941

FOR YEARS, SUICIDE HAS BEEN the fourth-leading cause of death in the United States for those between 10 and 65 years of age.¹ To prevent suicide, one strategy has been to identify and prevent the contributing circumstances (ie, risk factors) common to those who take their own lives. Health-related risk factors have included mental health (MH) problems²⁻⁶; certain medical conditions (eg, cancer)⁷⁻⁹; prior suicide attempts²; and substance abuse.^{2,10} Other life-stress-related risk factors have included intimate partner (IP) problems¹¹; job loss¹²⁻¹⁴ or financial problems¹⁵; recent crisis or stress²; and experiences with other forms of violence (eg, child abuse or peer abuse).^{16,17} While any one of these factors increases the risk of suicide, most suicide decedents have

multiple risk factors prior to death.² Therefore, strategies designed to prevent suicide might be more effective if they address multiple risk factors.² To provide direction for such strategies, we identified common patterns of health-related and life-stress-related factors (ie, the most common co-occurring factors) known to increase risk of suicide among a suicide decedent population, classified decedents by these patterns, and assessed annual class proportions during a 6-year period to determine which co-occurring factors need more urgent attention. We also characterized decedents (eg, demographic characteristics) and the incidents (eg, the mechanisms and weapons used, location of incident) by these patterns to further understand their surrounding circumstances.

Author Affiliations: Division of Violence Prevention, Etiology and Surveillance Branch, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia.

DATA SOURCE

The National Violent Death Reporting System (NVDRS) is an incident-based surveillance system that captures details on different types of violent deaths, including suicides.^{18,19} Data collection began in 2003 in 7 states (Alaska, Maryland, Massachusetts, New Jersey, Oregon, South Carolina, and Virginia). In 2004, 6 states were added (Colorado, Georgia, North Carolina, Oklahoma, Rhode Island, and Wisconsin). In 2005, 4 states were added (California, Kentucky, New Mexico, and Utah), bringing the total (as of 2008) to 17 states. Data collection is statewide with the exception of California, which collects data in only 4 counties (Los Angeles, Riverside, San Francisco, and Santa Clara).

The NVDRS collects details such as information on decedents, the mechanisms and weapons involved in the incidents, and the circumstances leading up to the violent deaths.¹⁸ Data are collected from coroner or medical examiner reports, toxicology reports, law enforcement records, and death certificates and are linked by incident into a single repository.

States manage data collection through state health departments or a subcontracted entity, such as a medical examiner's office, where data are gathered and coded by trained abstractors. Data may be manually extracted from reports or imported electronically from other systems (eg, Bureau of Vital Statistics death certificate files). All data are reviewed by the abstractor to ensure accuracy of the codes and adherence to the NVDRS coding manual.²⁰ The NVDRS has been described in further detail elsewhere.^{18,20}

CASE DEFINITION AND POPULATION

The data used for this analysis represent calendar years 2003 to 2008. Case identification was conducted from an NVDRS database that was updated through March 2010. Suicide decedents were identified by the final manner of death they were assigned by the data abstractors; abstractors make this determination using information from the death certificates (ie, the listed manner of death and the external cause of death codes) as well as from the coroner or medical examiner and law enforcement reports. Based on this initial criterion, 49 265 suicide decedents were identified from 17 states. Two additional inclusion criteria were also required. First, because this study focused on patterns of co-occurring risk factors, a case had to have circumstance information documented for at least 2 health-related or life-stress-related risk factors. This criterion yielded 36 756 cases (74.6%) overall. Second, states had to have at least two-thirds of their cases meet this first criterion to be included. States that did not meet this criterion might have had difficulties with capturing suicide circumstance information. In such situations, it is likely that circumstance data were not missing at random; therefore, a fair assessment of patterns for these states might have been problematic. As a result of this criterion, cases from 5 states (South Carolina, Georgia, Kentucky, California, and New Jersey) were excluded. The final sample included 28 703 cases from 12 NVDRS states.

VARIABLES

The known health-related and life-stress-related risk factors used to assess the patterns included having a current depressed mood; a current MH condition (ie, a documented condition); a history of MH conditions (approximated by having a history of MH treatment); alcohol problems; other substance abuse problems; medical problems believed to have pre-

cipitated the suicide (eg, chronic pain or cancer); financial problems; job problems; criminal legal problems; a recent crisis (within 2 weeks); a recent exposure to a death (eg, recent death of a friend or family member); IP or other relationship problems; a history of perpetrating interpersonal violence; and a history of suicide attempts. We also included information on whether the decedent was suspected of using alcohol at the time of the incident and whether the decedent disclosed his or her intent to commit suicide. All of the variables were not mutually exclusive. Three known risk factors (ie, school problems, other legal problems, and violence victimization) were excluded because of low prevalence estimates. (Throughout this article, we use the term *known risk factors* because these items have been identified as risk factors for suicide in previous studies; in the NVDRS, these items are often referred to as "preceding circumstances of suicide" because the system is currently unable to assess relative risk.)

After categorization by the pattern of known risk factors, we also characterized the decedents by demographic factors (eg, race/ethnicity, sex, age, and marital status), military status (ie, whether the decedent ever served in the US military), and whether they accessed MH treatment prior to death. We also characterized the incidents by the type of location (eg, home, recreational area, or commercial area) and the type of mechanism and weapon used (eg, firearm, poisoning, hanging).

STATISTICAL ANALYSIS

Latent class analysis (LCA) was used to identify distinct patterns of known risk factors for suicide among the decedents and to classify these decedents by these patterns. The LCA method is very useful in identifying distinct classes based on patterns of nonmutually exclusive categorical variables²¹ such as the known risk factors.²¹ To determine which model best explained the patterns of known risk factors (eg, a 3-class model identifies 3 classes [or patterns], a 4-class model identifies 4 classes, and so forth), we used the Bayesian information criterion (see footnote i of the eAppendix, <http://www.archgenpsychiatry.com>). We also considered the entropy value (see footnote ii of the eAppendix). Based on these criteria, we chose a 9-class model. Details on LCA and our model selection process are provided in the eAppendix and eTable. This analysis was first conducted for suicide decedents in each NVDRS data year to assess the stability of latent class structures (eg, whether the characteristics of each class identified were similar in each data year). Because the same classes (ie, distinct patterns) emerged in each data year, we then consolidated the data for the 2003 through 2008 data years. All LCAs were performed using Mplus version 5.1 statistical software (Muthen and Muthen, Los Angeles, California).

To show how each class had distinct patterns of known risk factors, we provided the class-specific item endorsement probabilities for each factor. We also assessed the proportion of each class by year and characterized each of the classes by the descriptive variables. The Cochran-Armitage test for trends was used to test for the presence of linear trends in the proportion of decedents in each latent class across data years examined in this study. The tests determine significant increases or decreases in class proportions using data from all years beyond a reference year. Because the NVDRS was expanding from 2003 through 2005, significant changes detected by these tests might have been an artifact of the system capturing more cases; therefore, Cochran-Armitage tests were conducted for each class using 3 starting points: 2003, 2004, and 2005. Each analysis used 2-tailed tests, and significance was determined at the $P=.05$ level.

Table 1. Probabilities for Known Suicide-Related Risk Factors and Categories of Risk Factor Patterns Among 28 703 Suicide Decedents in the National Violent Death Reporting System Between 2003 and 2008

Factor	Class of Risk Factor Patterns, Probability ^a								
	1 (n=2567)	2 (n=4193)	3 (n=7138)	4 (n=3574)	5 (n=1249)	6 (n=2641)	7 (n=1875)	8 (n=3015)	9 (n=2451)
Health related									
Current depressed mood	0.651	0.634	0.415	0.730 ^{b,c}	0.641	0.589	0.172	0.301	0.378
Current MH condition	0.961 ^b	0.974 ^b	0.991 ^{b,c}	0.070	0.088	0.075	0.024	0.033	0.097
Suspected alcohol use	0.738	0.184	0.222	0.242	0.820 ^{b,c}	0.109	0.323	0.496	0.795 ^b
Alcohol dependence	0.826 ^c	0.000	0.093	0.049	0.814	0.026	0.089	0.110	0.492
Other substance abuse problems	0.361 ^c	0.144	0.114	0.107	0.345	0.028	0.145	0.103	0.299
Medical health problems	0.165	0.254	0.224	0.170	0.158	1.000 ^{b,c}	0.029	0.025	0.152
Life stress									
Crisis in past 2 wk	0.454	0.576	0.000	0.307	0.611	0.348	0.823 ^{b,c}	0.694	0.000
Financial problems	0.202	0.199	0.031	0.360 ^c	0.353	0.042	0.045	0.054	0.060
Job problems	0.247	0.209	0.035	0.342	0.410 ^c	0.016	0.055	0.025	0.039
Recent criminal legal problems	0.165	0.109	0.012	0.097	0.281	0.003	0.661 ^c	0.000	0.073
IP problems	0.486	0.462	0.058	0.295	0.577	0.034	0.424	1.000 ^{b,c}	0.240
Other relationship problems	0.187	0.208	0.025	0.201	0.235	0.028	0.244 ^c	0.057	0.086
Death of a friend or family member	0.092	0.073	0.058	0.150 ^c	0.074	0.090	0.034	0.017	0.061
Perpetrated interpersonal violence	0.048	0.050	0.000	0.004	0.083	0.003	0.342 ^c	0.162	0.002
MH history									
History of suicide attempts	0.428 ^c	0.344	0.314	0.116	0.183	0.060	0.071	0.118	0.193
Ever treated for MH condition	0.931	0.942 ^c	0.929	0.017	0.014	0.005	0.006	0.006	0.031
Disclosed intent	0.458	0.408	0.243	0.305	0.474 ^c	0.388	0.214	0.316	0.306

Abbreviations: IP, intimate partner; MH, mental health.

^aClass 1 indicates MH conditions with alcohol problems; class 2, MH conditions with recent crises; class 3, MH conditions only; class 4, current depressed mood with financial problems; class 5, alcohol problems with other life stresses; class 6, medical problems with depressed mood; class 7, recent crises with criminal legal problems; class 8, IP problems with recent crises; and class 9, suspected of alcohol use at time of death.

^bMost common characteristic in the class.

^cHighest probability for the characteristic across the classes.

RESULTS

CLASS ASSIGNMENT FOR PATTERNS OF KNOWN RISK FACTORS

The number of classes, the proportion of respondents assigned to each class, and the endorsement probabilities for each factor by class are presented in **Table 1**.

Class 1 exemplified MH conditions with alcohol problems (n=2567 [8.9%]). This class endorsed high probabilities for MH-related risk factors, alcohol dependence, and suspected alcohol use at the time of death. Compared with other classes, this group also had the highest probabilities for having other substance abuse problems and previous suicide attempts.

Class 2 displayed MH conditions with recent crises (n=4193 [14.6%]). This class had high probabilities for all MH-related risk factors as well as a moderately high probability for having a crisis within 2 weeks of death. This class differed from the first by having low probabilities for alcohol and substance abuse problems.

Class 3 had MH conditions only (n=7138 [24.9%]). This class was the last of the 3 classes that endorsed all of the MH-related risk factors. In contrast to the first 2 classes, this class had low probabilities for all other factors.

Class 4 decedents had a current depressed mood with financial problems (n=3574 [12.5%]). This class had a high probability for being recognized as having a depressed mood around the time of death; however, they had a low probability for having a documented MH con-

dition. This class also had the highest probability for having experienced financial problems.

Class 5 exhibited alcohol problems with other life stresses (n=1249 [4.4%]). These decedents had high probabilities for alcohol-related risk factors and moderate to high probabilities for a variety of life stresses (eg, a recent crisis, job problems, IP problems). They also had a moderately high probability for being identified as having a depressed mood but a low probability for having a documented MH condition.

Class 6 had medical problems with depressed mood (n=2641 [9.2%]). For this class, the probability for having medical problems that were believed to have contributed to the suicide was 1.000, or 100%. Like classes 4 and 5, this class also had a moderately high probability for being identified as having a depressed mood but a low probability for having a documented MH condition.

Class 7 experienced recent crises with criminal legal problems (n=1875 [6.5%]). This group had the highest probabilities for having a recent crisis and recent criminal problems. This group also had moderate probabilities for having relationship problems and perpetrating interpersonal violence (eg, domestic violence, violence among acquaintances).

Class 8 encountered IP problems with recent crises (n=3015 [10.5%]). This group also had a moderately high probability for being suspected of alcohol use at the time of death.

Lastly, class 9 is characterized as being suspected of alcohol use at the time of death (n=2451 [8.5%]). This

Table 2. Suicide Class Allocation by Year Among 28 703 Suicide Decedents in the National Violent Death Reporting System Between 2003 and 2008^a

Class of Risk Factor Patterns	Year, %					
	2003 ^b	2004 ^c	2005 ^d	2006 ^d	2007 ^d	2008 ^d
Class 1: MH conditions with alcohol problems	6.7	8.0	8.8	9.1	9.9	9.5
Class 2: MH conditions with recent crises	10.9	13.9	13.6	15.2	15.9	15.6 ^e
Class 3: MH conditions only	27.2	25.7	23.1	23.8	24.9	26.0
Class 4: current depressed mood with financial problems	12.1	12.7	13.1	12.2	12.3	12.2
Class 5: alcohol problems with other life stresses	2.6	4.7	4.7	4.7	4.3	4.1
Class 6: medical health problems with depressed mood	12.0	9.8	9.7	9.3	8.8	7.5 ^e
Class 7: recent crises with criminal legal problems	7.6	7.0	7.0	6.5	5.8	6.1 ^e
Class 8: IP problems with recent crises	10.8	10.1	11.4	10.4	10.5	10.0
Class 9: suspected alcohol use at time of death	10.0	8.1	8.7	8.8	7.7	9.0

Abbreviations: IP, intimate partner; MH, mental health.

^aBy year, cells may not total 100% due to rounding.

^bThe five 2003 states included Alaska, Maryland, Massachusetts, Oregon, and Virginia.

^cThe ten 2004 states included the previously selected 5 states plus Colorado, North Carolina, Oklahoma, Rhode Island, and Wisconsin.

^dThe twelve 2005-2008 National Violent Death Reporting System states included the previously selected 10 states plus New Mexico and Utah.

^eBased on Cochran-Armitage tests, class proportions were determined to have changed during the study period. Three tests were conducted, each using a different reference year: 2003, 2004, and 2005. Significant changes from the reference year, accounting for all subsequent data years, were observed in each test. For each test, significance was observed at the $P=.05$ level.

class also had a moderately high probability for having history of alcohol dependence.

SUICIDE CLASS PROPORTIONS BY YEAR FROM 2003 THROUGH 2008

Across all years, class 3 was the most common class of decedents (**Table 2**). The Cochran-Armitage tests supported significant changes in the class proportions for 3 classes, regardless of which reference year (2003, 2004, or 2005) was used (comparisons were significant at the $P=.05$ level). The annual proportion of decedents allocated to class 2 significantly increased during the study period, while the annual proportions of decedents allocated to classes 6 and 7 steadily decreased in this time.

OTHER CHARACTERISTICS

Many similarities were observed across the classes. For example, in each class, most decedents ($\geq 73.9\%$) were of white non-Hispanic racial/ethnic status, most decedents ($\geq 64.0\%$) were male, the most common mechanism or weapon used was a firearm ($\geq 38.5\%$), and the most common location of death was at a house or an apartment ($\geq 59.5\%$) (**Table 3**). Also, classes 1 through 3 (those identified with a current MH condition) had similar patterns of MH diagnoses, with depression or dysthymia listed as the most common diagnosis (75.2%-77.8%), bipolar disorder as the second most common diagnosis (13.5%-14.7%), and anxiety disorder as the third most common disorder (7.7%-9.1%).

Several differences were also discovered. Classes 1 through 3, those with documented MH conditions, had the highest proportions of female decedents (25.6%-36.1%). These 3 classes were the only classes who had decedents in MH treatment prior to death ($\geq 75.9\%$ were in treatment) and were the 3 classes with the highest proportion of decedents who died by poisoning ($\geq 25.2\%$). Class 7 (those with recent crises and criminal legal prob-

lems) had the highest proportion of decedents younger than 20 years, whereas class 6 decedents (those with contributing medical problems) had the highest proportion of decedents aged 65 years or older. Class 6 also had the highest proportion of decedents who were widowed, divorced, or separated from their spouse and who had served in the military.

COMMENT

Suicide is a complex phenomenon often resulting from multiple risk factors.^{2,22} We found that distinct patterns among these factors exist. Similar to previous research, we found the following: the majority of decedents were non-Hispanic white males^{1,23}; the most common place of death was at a residence²⁴; the most common mechanism or weapon used was a firearm^{23,25}; decedents with contributing medical problems were older⁷; those with criminal legal problems were younger^{26,27}; and many decedents who had MH conditions also had substance abuse problems.²⁸⁻³¹ Furthermore, previous research found that females are more likely than males to access MH treatment^{32,33} and attempt suicide by poisoning or less lethal means.³⁴⁻³⁷ Therefore, as expected, we found higher proportions of females and poisoning deaths among classes with higher proportions of decedents who accessed MH treatment.

Additionally, we found that more than 10 000 decedents who had MH issues (ie, who either had a documented condition or were known to have a sad or depressed mood) were experiencing other risk factors prior to death and that the proportions of decedents experiencing MH problems with a recent crisis (class 2) have been increasing in recent years, although more years of data might be needed to substantiate this trend. Furthermore, at least 75% of those in classes 1 through 3—classes that consisted of half the entire decedent population—were in MH treatment around the time of death, which

Table 3. Descriptive Characteristics by Class Among 28 703 Suicide Decedents in the National Violent Death Reporting System Between 2003 and 2008^a

Characteristic	Class of Risk Factor Patterns, % ^b								
	1 (n=2567)	2 (n=4193)	3 (n=7138)	4 (n=3574)	5 (n=1249)	6 (n=2641)	7 (n=1875)	8 (n=3015)	9 (n=2451)
Race/ethnicity									
White non-Hispanic	90.0	88.0	88.9	83.0	85.5	92.6	73.9	75.5	81.8
Black non-Hispanic	2.9	4.4	5.0	5.8	2.8	2.8	12.4	9.5	4.6
Hispanic	4.4	4.3	2.7	6.2	7.8	2.3	8.2	9.1	7.4
Other	2.8	3.2	3.4	5.0	3.9	2.3	5.6	5.9	6.2
Sex									
Male	74.4	67.3	64.0	84.2	90.7	84.1	92.6	85.5	84.6
Female	25.6	32.8	36.1	15.8	9.3	15.9	7.4	14.5	15.4
Age, y									
≤19	2.7	7.6	3.7	6.0	2.5	0.5	12.3	7.6	3.7
20-34	24.3	25.3	18.8	24.7	28.7	3.8	33.2	39.9	28.0
35-49	43.4	36.4	31.5	33.4	44.5	11.6	33.2	35.6	38.6
50-64	26.1	21.9	30.5	26.7	21.6	23.6	17.8	13.3	23.5
≥65	3.4	8.8	15.4	9.2	2.7	60.6	3.5	3.7	6.2
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marital status									
Married	37.4	44.6	35.8	33.4	34.4	46.4	31.7	45.3	30.1
Never married, single not otherwise specified	31.9	30.3	32.6	36.1	34.0	13.0	44.0	34.2	39.5
Widowed, divorced, separated	30.4	24.8	31.2	30.0	31.1	40.4	23.3	20.0	29.8
Unknown	0.3	0.3	0.5	0.6	0.5	0.2	1.1	0.4	0.6
MH diagnosis ^c									
Depression or dysthymia	77.8	75.4	75.2						
Bipolar disorder	14.5	14.7	13.5						
Schizophrenia	3.5	2.9	6.3						
Anxiety disorder	8.9	9.1	7.7						
Posttraumatic stress disorder	2.1	1.6	1.4						
Other	5.4	7.4	5.4						
Currently in MH treatment									
No	24.1	19.4	19.6	100.0	100.0	100.0	100.0	100.0	100.0
Yes	75.9	80.6	80.4	0.0	0.0	0.0	0.0	0.0	0.0
Type of location where injured ^d									
House or apartment	81.9	77.7	76.6	73.7	81.1	86.6	59.5	78.3	76.7
Public transport, recreational, or commercial	9.7	12.9	12.5	14.5	10.5	8.0	20.6	13.7	13.5
Other	8.0	9.2	10.2	11.6	8.4	5.4	19.8	7.9	9.2
Unknown	0.4	0.2	0.8	0.3	0.0	0.1	0.1	0.1	0.7
Mechanism or weapon type									
Firearm	39.8	43.2	38.5	55.2	55.7	74.1	59.3	61.4	48.4
Poisoning	30.0	25.2	31.4	13.8	12.3	13.8	7.4	9.8	19.1
Hanging	23.6	25.1	20.5	25.5	28.1	7.4	27.7	23.5	27.4
Other	6.7	6.5	9.5	5.5	3.9	4.7	5.6	5.3	5.1
Ever served in the US military									
No	79.1	80.5	73.6	75.2	78.7	50.7	78.1	78.3	72.3
Yes	17.5	16.3	18.3	20.4	18.7	46.4	17.4	17.0	18.0
Unknown	3.4	3.2	8.1	4.4	2.6	3.0	4.5	4.7	9.8

Abbreviations: IP, intimate partner; MH, mental health.

^aFor each variable grouping, cells may not total 100% due to rounding.

^bClass 1 indicates MH conditions with alcohol problems; class 2, MH conditions with recent crises; class 3, MH conditions only; class 4, current depressed mood with financial problems; class 5, alcohol problems with other life stresses; class 6, medical problems with depressed mood; class 7, recent crises with criminal legal problems; class 8, IP problems with recent crises; and class 9, suspected of alcohol use at time of death.

^cDiagnoses are listed for those identified as having a current MH condition. Most of these decedents (93.9%) were classified in the first 3 classes; therefore, diagnoses were provided for only these classes. There were 2457 decedents in class 1, 4070 decedents in class 2, and 7073 decedents in class 3 who had current MH conditions. Diagnoses could have been listed as either the primary diagnosis or the secondary diagnosis. Decedents could have multiple diagnoses; therefore, diagnostic categories are not mutually exclusive.

^dOther residential areas include shelters and prisons. Transport areas include public highways, streets or roads, or inside a motor vehicle.

suggests that more suicide prevention strategies are needed with treatment. The MH treatment alone might not sufficiently address both the MH condition and potential co-occurring life stressors, or these stressors might be disrupting the treatment process (eg, a recent crisis or substance abuse might deter compliance with treatment

regimens). For those with only MH conditions, additional social support might still be needed to help monitor treatment and prevent suicidal behavior.

We also found that many decedents had a recent crisis with IP or other relationship problems in the absence of having known MH conditions, as indicated by

classes 7 and 8. These findings suggest that there might be a need for services that help build strong coping skills to better handle relationship issues during times of crises, especially because a high proportion of the class 7 decedents perpetrated interpersonal violence prior to death. Furthermore, a high proportion of class 7 decedents had criminal legal problems, indicating that the court/legal system might be in a position to act as a gateway for multicomponent suicide and violence prevention strategies. Such strategies can incorporate individual counseling with family therapy, counseling on building positive relationships and coping skills, and assistance with accessing additional resources that can help reduce stress on relationships (eg, employment assistance programs).³⁸

Similar to Flensburg-Madsen et al,³⁹ we also found that alcohol-related problems can be common among suicide decedents in the absence of psychiatric comorbidity, as indicated by classes 5 and 9. Alcohol-related problems were the most transparent characteristics for these decedents. Both of these classes had moderate probabilities for being identified as having a sad or depressed mood, which could mean they had MH problems that were not yet diagnosed. The class 5 decedents had moderately high probabilities for having a recent crisis and other life stressors, suggesting that these decedents might have been using alcohol as a coping device, which warrants efforts to reduce this maladaptive coping behavior in favor of more socially adaptive ways of dealing with stress.

The link between medical illness and depression with suicide in older adults is well documented.⁴⁰⁻⁴² This study found that class 6 decedents (those with contributing medical problems) mostly comprised older adults. Nearly half of them were identified as having a depressed mood, which indicates a need for increasing social support and MH screening and treatment once diagnosed as having a severe or terminal medical condition. Class 6 deaths were also characterized by the highest proportion of widowed, divorced, or separated decedents and more than double the number of decedents with prior military service than any other class, both of which may indicate the need for additional support systems.

In light of these findings, many limitations of this study should be considered. First, the NVDRS data were not nationally representative. As the NVDRS expands to include all 50 states, the class structure, the class proportions, or both might change over time. Second, changes in class proportions over time might be a reflection of changes in the population demographic characteristics, which signifies that scientists must continue to observe patterns of risk factors if they hope to help prevent suicide. Third, the reported information on MH and medical health problems and substance abuse was obtained from coroners and medical examiners, family members, and friends of the victims. As such, it may be incomplete based on the knowledge level of the informant. Furthermore, many of these decedents might have been living with MH conditions but never received a diagnosis. Because of the potential underdiagnosis of MH conditions, the proportion of decedents placed in classes 4 through 9 might have been overestimated and the proportion estimates for classes 1 through 3 might have been

underestimated. Fourth, 5 states had to be excluded because of lack of circumstance information. The excluded population did not largely differ from the study population by demographic characteristics such as race/ethnicity, sex, and age (significant differences were detected because large populations were compared, but the differences were slight); therefore, potential biases associated with population demographic characteristics were most likely minimal. However, our findings should still be generalized only to the population of the 12 NVDRS states included in the study. The fact that 5 states were excluded because of the lack of suicide circumstance information signifies the need for thorough reporting on suicide deaths by medicolegal death investigators to appropriately monitor suicide trends. Lastly, LCA can often lead to subjective interpretation of class patterns; however, the victim demographic and mechanism or weapon characteristics we observed across the classes were similar to the correlations observed in previous research. These characteristics helped validate the existence of the patterns we identified. More research is still needed to help understand why different populations are drawn into different patterns of risk factors for suicide.

Suicide is a complex problem that is typically precipitated by a variety of circumstances. With the use of LCA, this study identified patterns of known risk factors among decedents, which can hopefully provide more direction on how to develop or combine prevention efforts. For ongoing suicide mortality surveillance initiatives, this type of analysis also provides a more accurate and comprehensive picture of the surrounding circumstances experienced by suicide decedents. In this study, the common theme across most classes of decedents was a need for more connected medical, MH, substance abuse, court, and social services; one service alone might not sufficiently prevent this problem. Furthermore, all decedents needed more social support, even those who were currently receiving MH counseling or treatment. Initiatives that recruit family, friends, and community members to help those experiencing high levels of mental and/or life stress might further help prevent suicide.

Submitted for Publication: October 27, 2010; final revision received April 5, 2011; accepted April 17, 2011.

Correspondence: Joseph Logan, PhD, Division of Violence Prevention, Etiology and Surveillance Branch, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 4770 Buford Hwy, MS-F63, Atlanta, GA 30341-3724 (ffa3@cdc.gov).

Author Contributions: Dr Logan had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Financial Disclosure: None reported.

Funding/Support: This study was supported by the Centers for Disease Control and Prevention.

Role of the Sponsor: The Centers for Disease Control and Prevention funding was provided for the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, and approval of the manuscript.

Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily repre-

sent the views of the Centers for Disease Control and Prevention or the Agency for Toxic Substances and Disease Registry.

Online-Only Material: The eAppendix and eTable are available at <http://www.archgenpsychiatry.com>.

REFERENCES

- Centers for Disease Control and Prevention. Web-Based Injury Statistics Query and Reporting System (WISQARS). <http://www.cdc.gov/injury/wisqars/index.html>. Accessed February 3, 2010.
- Mościcki EK. Epidemiology of suicide. *Int Psychogeriatr*. 1995;7(2):137-148.
- Almasi K, Belso N, Kapur N, Webb R, Cooper J, Hadley S, Kerfoot M, Dunn G, Sotonyi P, Rihmer Z, Appleby L. Risk factors for suicide in Hungary: a case-control study. *BMC Psychiatry*. 2009;9:45.
- Brådvik L, Mattisson G, Bøgren M, Nettelbladt P. Mental disorders in suicide and undetermined death in the Lundby Study: the contribution of severe depression and alcohol dependence. *Arch Suicide Res*. 2010;14(3):266-275.
- Brådvik L, Berglund M. Depressive episodes with suicide attempts in severe depression: suicides and controls differ only in the later episodes of unipolar depression. *Arch Suicide Res*. 2010;14(4):363-367.
- Ilgen MA, Bohnert AS, Ignacio RV, McCarthy JF, Valenstein MM, Kim HM, Blow FC. Psychiatric diagnoses and risk of suicide in veterans. *Arch Gen Psychiatry*. 2010;67(11):1152-1158.
- Grabbe L, Demi A, Camann MA, Potter L. The health status of elderly persons in the last year of life: a comparison of deaths by suicide, injury, and natural causes. *Am J Public Health*. 1997;87(3):434-437.
- Miller M, Mogun H, Azrael D, Hempstead K, Solomon DH. Cancer and the risk of suicide in older Americans. *J Clin Oncol*. 2008;26(29):4720-4724.
- Quan H, Arboleda-Flórez J, Fick GH, Stuart HL, Love EJ. Association between physical illness and suicide among the elderly. *Soc Psychiatry Psychiatr Epidemiol*. 2002;37(4):190-197.
- Kung HC, Pearson JL, Liu X. Risk factors for male and female suicide decedents ages 15-64 in the United States: results from the 1993 National Mortality Followback Survey. *Soc Psychiatry Psychiatr Epidemiol*. 2003;38(8):419-426.
- Centers for Disease Control and Prevention. Homicides and suicides: National Violent Death Reporting System, United States, 2003-2004. *MMWR Morb Mortal Wkly Rep*. 2006;55(26):721-724.
- Heikkinen ME, Lönnqvist JK. Recent life events in elderly suicide: a nationwide study in Finland. *Int Psychogeriatr*. 1995;7(2):287-300.
- Høyer EH, Licht RW, Mortensen PB. Risk factors of suicide in inpatients and recently discharged patients with affective disorders: a case-control study. *Eur Psychiatry*. 2009;24(5):317-321.
- Kölvés K, Várnik A, Schneider B, Fritze J, Allik J. Recent life events and suicide: a case-control study in Tallinn and Frankfurt. *Soc Sci Med*. 2006;62(11):2887-2896.
- Stack S, Wasserman I. Economic strain and suicide risk: a qualitative analysis. *Suicide Life Threat Behav*. 2007;37(1):103-112.
- Klomek AB, Sourander A, Niemelä S, Kumpulainen K, Piha J, Tamminen T, Almqvist F, Gould MS. Childhood bullying behaviors as a risk for suicide attempts and completed suicides: a population-based birth cohort study. *J Am Acad Child Adolesc Psychiatry*. 2009;48(3):254-261.
- Maniglio R. The role of child sexual abuse in the etiology of suicide and non-suicidal self-injury [published online October 11, 2010]. *Acta Psychiatr Scand*. doi:10.1111/j.1600-0447.2010.01612.x.
- Paulozzi LJ, Mercy J, Frazier L Jr, Annett JL; Centers for Disease Control and Prevention. CDC's National Violent Death Reporting System: background and methodology. *Inj Prev*. 2004;10(1):47-52.
- Steenkamp M, Frazier L, Lipskiy N, Deberry M, Thomas S, Barker L, Karch D. The National Violent Death Reporting System: an exciting new tool for public health surveillance. *Inj Prev*. 2006;12(suppl 2):ii3-ii5.
- Centers for Disease Control and Prevention. National Violent Death Reporting System (NVDRS) Coding Manual, 2003. <http://www.cdc.gov/injury>. Accessed July 13, 2010.
- Hagenaars JA, McCutcheon AL. *Applied Latent Class Analysis*. Cambridge, England: Cambridge University Press; 2002.
- Mościcki EK. Identification of suicide risk factors using epidemiologic studies. *Psychiatr Clin North Am*. 1997;20(3):499-517.
- Hu G, Wilcox HC, Wissow L, Baker SP. Mid-life suicide: an increasing problem in US whites, 1999-2005. *Am J Prev Med*. 2008;35(6):589-593.
- Karch DL, Dahlberg LL, Patel N, Davis TW, Logan JE, Hill HA, Ortega L; Centers for Disease Control and Prevention. Surveillance for violent deaths: National Violent Death Reporting System, 16 states, 2006. *MMWR Surveill Summ*. 2009;58(1):1-44.
- Ajdacic-Gross V, Weiss MG, Ring M, Hepp U, Bopp M, Gutzwiller F, Rössler W. Methods of suicide: international suicide patterns derived from the WHO mortality database. *Bull World Health Organ*. 2008;86(9):726-732.
- Beautrais AL, Joyce PR, Mulder RT. Precipitating factors and life events in serious suicide attempts among youths aged 13 through 24 years. *J Am Acad Child Adolesc Psychiatry*. 1997;36(11):1543-1551.
- Donald M, Dower J, Lucke J, Raphael B. Prevalence of adverse life events, depression and suicidal thoughts and behaviour among a community sample of young people aged 15-24 years. *Aust N Z J Public Health*. 2001;25(5):426-432.
- Deykin EY, Levy JC, Wells V. Adolescent depression, alcohol and drug abuse. *Am J Public Health*. 1987;77(2):178-182.
- Christie KA, Burke JD Jr, Regier DA, Rae DS, Boyd JH, Locke BZ. Epidemiologic evidence for early onset of mental disorders and higher risk of drug abuse in young adults. *Am J Psychiatry*. 1988;145(8):971-975.
- Buckner JD, Timpano KR, Zvolensky MJ, Sachs-Ericsson N, Schmidt NB. Implications of comorbid alcohol dependence among individuals with social anxiety disorder. *Depress Anxiety*. 2008;25(12):1028-1037.
- Fergusson DM, Boden JM, Horwood LJ. Tests of causal links between alcohol abuse or dependence and major depression. *Arch Gen Psychiatry*. 2009;66(3):260-266.
- Mojtabai R. Americans' attitudes toward mental health treatment seeking: 1990-2003. *Psychiatr Serv*. 2007;58(5):642-651.
- Mackenzie CS, Gekoski WL, Knox VJ. Age, gender, and the underutilization of mental health services: the influence of help-seeking attitudes. *Aging Ment Health*. 2006;10(6):574-582.
- Kposowa AJ, McElvain JP. Gender, place, and method of suicide. *Soc Psychiatry Psychiatr Epidemiol*. 2006;41(6):435-443.
- Denning DG, Conwell Y, King D, Cox C. Method choice, intent, and gender in completed suicide. *Suicide Life Threat Behav*. 2000;30(3):282-288.
- Dombrovski AY, Szanto K, Duberstein P, Conner KR, Houck PR, Conwell Y. Sex differences in correlates of suicide attempt lethality in late life. *Am J Geriatr Psychiatry*. 2008;16(11):905-913.
- Kumar CT, Mohan R, Ranjith G, Chandrasekaran R. Characteristics of high intent suicide attempters admitted to a general hospital. *J Affect Disord*. 2006;91(1):77-81.
- Logan J, Hill HA, Black ML, Crosby AE, Karch DL, Barnes JD, Lubell KM. Characteristics of perpetrators in homicide-followed-by-suicide incidents: National Violent Death Reporting System, 17 US states, 2003-2005. *Am J Epidemiol*. 2008;168(9):1056-1064.
- Flensburg-Madsen T, Knop J, Mortensen EL, Becker U, Sher L, Grønbaek M. Alcohol use disorders increase the risk of completed suicide—irrespective of other psychiatric disorders: a longitudinal cohort study. *Psychiatry Res*. 2009;167(1-2):123-130.
- Harwood DM, Hawton K, Hope T, Harriss L, Jacoby R. Life problems and physical illness as risk factors for suicide in older people: a descriptive and case-control study. *Psychol Med*. 2006;36(9):1265-1274.
- Juurlink DN, Herrmann N, Szalai JP, Kopp A, Redelmeier DA. Medical illness and the risk of suicide in the elderly. *Arch Intern Med*. 2004;164(11):1179-1184.
- Labis O. Suicide risk assessment in the depressed elderly patient with cancer. *J Gerontol Soc Work*. 2006;47(1-2):17-25.