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## **Selected Topics: Toxicology**

### **VARIATION IN SUICIDE OCCURRENCE BY DAY AND DURING MAJOR AMERICAN HOLIDAYS**

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**Abstract—Background:** Due to temporal variations in completed suicides, it has been suggested that impulsivity and environmental factors may influence suicide. **Study Objective:** Our intent was to determine if particular days of the week, seasons, or holidays were associated with increased attempted and completed suicides by poisoning. **Methods:** All calls recorded in the National Poison Database System coded as “suspected suicide” from 2006 through 2010 were included. Exposures were evaluated by day, season, and holidays, and compared to control dates. **Results:** There were 1,065,067 exposures (63% female) related to suicide attempts, with completions in 0.4% of cases. Sundays and Mondays for adults, and Mondays and Tuesdays for age < 19 years were the most common. Spring and fall had higher numbers of exposures than summer and winter. New Year's Day had a higher number of exposures, whereas Independence Day, Thanksgiving, and Christmas had fewer exposures. **Conclusions:** The beginning of the week, spring and fall, and New Year's Day were associated with higher numbers of ingestions with suicidal intent. This has implications for clinicians advising potential victims and providing emergency care for these patients. © 2014 Elsevier Inc.

**Keywords—suicide; overdose; seasonal variation; prevention; holidays**

#### **INTRODUCTION**

According to the U.S. Centers for Disease Control and Prevention, there were 6398 poisoning suicide attempts

resulting in death in the United States (US) in 2009, a rate of 2.1 deaths per 100,000 population (1). Prior studies have demonstrated a large burden in disability-adjusted life years (years of healthy life lost through premature death or disability) worldwide, with lives lost via suicide representing an estimated 1.5% of the global burden of human disease, with an estimated annual death toll by suicide of a million deaths per year worldwide (2,3). A systematic review of prevention strategies identified physician education in depression recognition and restriction of access to lethal means as interventions more likely to be successful in preventing suicide (2). Further, it is estimated that up to 66% of individuals who experience death by suicide have had contact with a physician within 1 month preceding death, and that 43% of completed suicides have been seen in an emergency department (ED) within the last year prior to death (4–6). Prior epidemiological studies have aimed to identify patterns of disease in order to identify modifiable factors with potential to inform prevention strategies (7). Physician knowledge of temporal factors that may contribute to increased risk of suicidality may help facilitate the ongoing evolution of prevention strategies used in both the outpatient and ED settings and may inform resource utilization for both EDs and poison control centers fielding psychiatric emergencies involving suicide attempt by overdose.

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Due to the observed seasonality and daily variations in completed suicides, it has been suggested that environmental factors and how they relate to mood may play a role in suicide. Previous studies have evaluated suicide attempts according to seasonality, lunar phase, day of week, and time of call to a Poison Control Center (8–14). The beginning of the week has been shown to have increased numbers of completed suicides, although recent studies showed an increase in overall death from suicides on Wednesdays (10,12). Suicide attempt by poisoning is the most common method utilized in the US, but has relatively low rates of success compared to more violent methods (15). For this reason, these attempts have sometimes been considered a “cry for help” and may be more influenced by impulsivity and environmental factors (16). The purpose of this study was to determine if particular days of the week, months, or holidays were associated with increased number of suicide attempts by poisoning.

## MATERIALS AND METHODS

### *Study Design*

This is a retrospective database study characterizing all calls about suicide attempts by poisoning reported to the National Poison Data System (NPDS). The institutional review board at our institution approved this study.

### *Data Collection*

All calls recorded in the NPDS that were coded as “suspected suicide” during the period January 1, 2006–December 31, 2010 were included. NPDS is a database of information logged by the country’s 57 poison centers and maintained by the American Association of Poison Control Centers (AAPCC). Any exposure calls, as defined by actual or suspected contact with any substance that had been ingested, inhaled, absorbed, applied to or injected into the body were included. Only closed cases (all poison control center follow-up on the case was complete at the time of data retrieval) were reviewed. Standardized data elements are collected and coded by trained professionals at the time of each call. Data collected for each case included age, gender, month and year of the exposure, substance(s) involved, amount ingested, reason (intent) for exposure, disposition of patient, and poison center outcome designation.

### *Definitions*

Suspected suicide as defined by the AAPCC includes “an exposure resulting from the inappropriate use of a substance for reasons that are suspected to be self-

destructive or manipulative.” Poison center medical outcome designations are coded according to the AAPCC definitions. They are designated as follows: 1) No effect; 2) Not followed, judged as nontoxic exposure; 3) Minimal clinical effects possible; 4) Minor; 5) Moderate; 6) Major; 7) Unable to follow – potentially toxic effect; 8) Unrelated; and 9) Death. Please refer to the AAPCC annual report for full definitions (17). Seasons were defined by month: winter (December, January, February); spring (March, April, May); summer (June, July, August); fall (September, October, November).

### *Data Analysis*

General linear model (GLM) procedure was used to determine if exposures were reported more commonly during a day of the week. In addition, using the Student’s *t*-test, the number of exposures occurring on the following holidays: New Year, Martin Luther King Jr. Day, Valentine’s Day, Easter, Mother’s Day, Memorial Day, Father’s Day, Independence Day, Labor Day, Thanksgiving, and Christmas; as well as the 1 day (3 days inclusive) and 3 days (7 days inclusive) prior to and after each holiday were compared to three control dates, March 15, June 15, and September 15 for the 5 years of the study. In addition, using the GLM procedure, the 3 days prior to each holiday was compared to the 3 days after each holiday to detect whether a fall in exposures prior to any given holiday was followed by a rise and vice versa. SAS v. 9.3 (SAS Institute Inc., Cary, NC) was used for all statistical analysis.

## RESULTS

There were 1,065,067 exposures related to suicide attempts or completions during the study period for an average of 583 per day. This represented approximately 8.7% of the total exposures reported to NPDS over the study period. Deaths occurred in 3790 (0.4%) of the cases reviewed. Females represented 63% of the total exposures. There was a significant trend of increase in the number of annual attempts reported to NPDS over the study period ( $p = 0.03$ ) (Table 1), with a significant increase in mean daily exposures each year from 2006 (544.7/day) until 2007 (571.7/day) ( $p < 0.0001$ ), and a nonsignificant increase in mean daily exposures from 2008 (595.6/day) until 2010 (602.1/day for 2009 and 602.3/day for 2010).

Sunday and Monday had the highest number of suicide attempts (Figure 1). When examined by age group, Sunday and Monday remained the most common days for all age groups except for the < 13 and 13–19 years age groups, in which Monday and Tuesday were the most common.

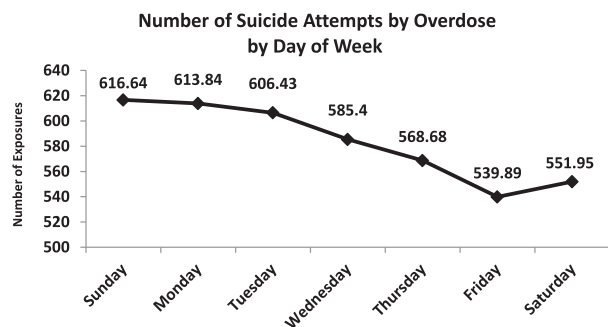
**Table 1. Patient and Exposure Demographics**

Mean age $\pm$ SD (years)	32.08 ( $\pm$ 14.24)
Total	1,065,067
Gender	
Male	386,039 (36%)
Female	672,669 (63%)
Unknown	6359 (1%)
Exposures	
Attempted suicide (not completed)	1,061,277
Attempted suicide (completed)	3790
Exposures in 2006	198,800
Exposures in 2007	208,653
Exposures in 2008	217,989
Exposures in 2009	219,776
Exposures in 2010	219,849
Effect	
Death	3790
Major effect	53,960
Moderate effect	253,330
Minor effect	328,184
No/minimal effect	257,024
Potentially toxic	155,350
Unrelated	13,429

SD = standard deviation.

Mean age, numbers, and percentages of males and females, and numbers of attempted and completed suicides and outcomes as categorized in the National Poison Database System (NPDS) (17).

New Year's Day was the only holiday with a significantly higher number of exposures than control days. Mean ( $\pm$  SD) daily exposures were 667.6 ( $\pm$  21.3) for New Year's Day vs. 597 ( $\pm$  57.7) for control days (Table 2). Independence Day, Thanksgiving, and Christmas days had significantly fewer exposures. The average number of attempts on control days (597/day) was not significantly different than the average number of attempts on all noncontrol days (583/day) ( $p = 0.29$ ). In an analysis of individual holidays and the 3 days prior to and after each holiday, no apparent pattern was found when comparing the holiday itself to the 3-day time periods prior to and after each holiday. In an analysis of all holidays combined, when the mean number of exposures on the 3 days preceding all holidays was compared



**Figure 1. Total number of suicide attempts by overdose by day of week. Total number of exposures per day of the week over the 5-year study period.**

to the mean daily number of exposures on the 3 days after all holidays, no difference was found ( $p < 0.0001$ ). By season, spring (595/day) and fall (591/day) had the highest number of exposures, with these two seasons showing significantly higher numbers of exposures than winter (567/day) and summer (580/day) ( $p < 0.0001$ ).

## DISCUSSION

Our study demonstrated that suicide attempts called to the poison center peaked on Sunday and Monday and then declined throughout the week. In addition, with the exception of New Year's Day, holidays were not associated with increased attempts, and in fact, certain holiday periods were associated with fewer suicide attempts by poisoning. Similar to prior studies on completed suicides that have shown an increase in exposures in the spring, we found an increase in suicide attempts by ingestion during spring and fall months when compared to the summer and winter months (8). The results of this study may inform approaches to suicide prevention by encouraging prevention techniques that take into account the complex influence of day of week, month, season, or holidays on mood, impulsivity, and suicidality.

A number of studies in the US and other countries have examined the temporal variation of suicide. In the majority of studies, Monday seems to be the most common day, although in a recently published study, it was Wednesday (10). In the majority of published studies, the spring season is the peak season for suicides (8,11). In various studies, there is also a decrease of suicides during major holidays and an increase on New Year's (18–20). Our study is unique in that it is a national sample of the US that is largely composed of suicide attempts and not completed suicides. Suicide attempt by poisoning, compared to less violent means of suicide, has been described as more impulsive (16). Given that the effect of seasonality, weekly variation, and holidays is similar to previous studies on completed suicides, this would suggest that similar psychosocial factors are involved in completed suicides as well as suicide attempts by poisoning. In addition, after a suicide attempt, about 25–30% will have second attempts (21,22).

Possible explanations for the protective holiday effect include the presence of family or other social support systems, which may be more available during holidays. Perceived parent and family connectedness was shown to be protective against suicide attempts in adolescents (23). Lower levels of family adaptability and family cohesion were also shown to be associated with suicide attempt (24). One theory that has been proposed is the “broken promises” theory, which states that individuals may be influenced by holidays because they tend to promote hope or improved moods. However, if the expectations are not

**Table 2. Mean Number of Exposures for Holidays and 3- and 7-day Periods Surrounding Holidays**

Holiday	Holiday		Holiday $\pm$ 1 day (3 days)		Holiday $\pm$ 3 days (7 days)	
	Mean Exposures $\pm$ SD	<i>p</i> -Value	Mean Exposures $\pm$ SD	<i>p</i> -Value	Mean Exposures $\pm$ SD	<i>p</i> -Value
New Year	*667.7 $\pm$ 21.3	0.02	578.3 $\pm$ 77.6	NS	<sup>v</sup> 567.3 $\pm$ 65	0.05
Martin Luther King Jr. Day	572.6 $\pm$ 70.6	NS	584.8 $\pm$ 65.2	NS	<sup>v</sup> 568.7 $\pm$ 58.9	0.03
Valentine's Day	573.2 $\pm$ 56.4	NS	579.2 $\pm$ 51.4	NS	585.8 $\pm$ 56.7	NS
Easter	590.6 $\pm$ 36.4	NS	583.5 $\pm$ 47.2	NS	584.9 $\pm$ 57.0	NS
Mother's Day	623.8 $\pm$ 51.2	NS	608.7 $\pm$ 59.9	NS	601.3 $\pm$ 51.9	NS
Memorial Day	625.8 $\pm$ 36.0	NS	621.9 $\pm$ 43.8	NS	592.4 $\pm$ 49.3	NS
Father's Day	607.6 $\pm$ 43.3	NS	586.0 $\pm$ 40.1	NS	<sup>v</sup> 572.1 $\pm$ 40.1	0.01
Independence Day	<sup>v</sup> 543.8 $\pm$ 18.82	0.01	<sup>v</sup> 557.3 $\pm$ 47.7	0.05	<sup>v</sup> 563.4 $\pm$ 54.7	0.01
Labor Day	644.8 $\pm$ 40.2	0.07	625.5 $\pm$ 37.6	NS	590.8 $\pm$ 55.2	NS
Thanksgiving	<sup>v</sup> 491 $\pm$ 16.7	0.0001	<sup>v</sup> 491.1 $\pm$ 32.4	0.0001	<sup>v</sup> 538.9 $\pm$ 56.9	0.001
Christmas	<sup>v</sup> 456.4 $\pm$ 33.8	0.0001	<sup>v</sup> 463.1 $\pm$ 34.6	0.0001	<sup>v</sup> 491.6 $\pm$ 41.4	0.0001

SD = standard deviation.

Mean number of exposures per holiday and surrounding days over 5-year study period. Exposures with \* are significantly increased from control days and those with <sup>v</sup> are significantly decreased from control days (Mean exposures for control days  $\pm$  SD was 597  $\pm$  57.7). Exposures for Holiday  $\pm$  1 and 3 days are calculated with 4 years of data for New Year's Day due to incomplete data set (missing data prior to January 1, 2006).

met, the individual may be frustrated and disappointed and perhaps prone to suicidal reactions (25,26). However, our study did not show a difference when the time period preceding holidays was compared to the time period after holidays. In our study, however, it could be interpreted that New Year's Day, Sunday and Monday, and the spring season have similar symbolic representations in that they all represent a new beginning—of the year, of the week, and of the season which most represents new life. It is possible that individuals see these times as positive events but become disappointed when their life circumstances remain unchanged.

In particular, patients experiencing suicidal ideation on a Sunday, or indeed on New Year's Day, may have limited access to contact with their clinician or therapist and may benefit from the preemptive recommendation by such a provider that the patient seek care by contacting a telephone hotline with operators available 24 h per day, or by visiting an emergency facility where care may be provided. Patients may benefit from the availability of "walk-in" clinic time on Mondays, after not having had access to clinical care over the weekend, as visits scheduled by telephone call on Mondays may occur too late in the week to prevent a suicide attempt or completion. Further studies are required to determine which specific approaches to advising patients is most beneficial in the prevention of suicide in anticipation of higher-risk days such as days early in the week or in preparation for New Year's Day each year. In addition, particular dates of the year may require increased availability of Poison Control Center resources or ED resources to manage increased numbers of attempted or completed suicides by overdose. Finally, our findings may inform approaches to suicide prevention by identifying potentially modifiable environmental risk factors.

### Limitations

The following factors may have limited the internal validity of this study. The circumstances surrounding each case were not available for review. It is possible that not every case reported was a true suicide attempt. In addition, the time used was the time that the call was received by the poison center. Thus, the actual attempt may have been on another day. Also, we used midnight as a cutoff, so early morning attempts may actually be an extension of events occurring on the previous night.

The following factors may have limited the external validity of this study. The reasons for any suicide attempt are likely to be an extremely complex combination of many psychosocial factors that cannot be explained simply by temporal factors. For example, our study is unable to account for socioeconomic status as well as regional variations in climate and culture, which may have significant effects on suicide attempts in the US. It is likely that the number of exposures studied may have been limited by underreporting to poison centers. Deaths are known to be underreported to poison centers (27).

### CONCLUSIONS

The beginning of the week and the spring and fall seasons were associated with higher numbers of suicide attempts reported to US poison centers. New Year's Day had a higher number of suicide attempts when compared to control days, although other holidays had no effect or had fewer attempts. This is similar to previous studies on completed suicides and smaller poison center-based studies suggesting that similar individual and environmental factors are involved between suicide attempt by poisoning and completed suicide.

Physician knowledge of temporal factors that may contribute to increased risk of suicidality may help facilitate the ongoing evolution of emergency prevention strategies and may guide resource utilization strategies for EDs seeing these patients.

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## ARTICLE SUMMARY

### **1. Why is this topic important?**

Emergency physician knowledge of temporal factors that may contribute to increased risk of suicidality can help facilitate the ongoing evolution of emergency prevention strategies and may guide resource utilization strategies for emergency departments seeing these patients.

### **2. What does this study attempt to show?**

This study sought to determine if particular days of the week, seasons, or holidays were associated with increased attempted and completed suicides by poisoning.

### **3. What are the key findings?**

This study demonstrated that the beginning of the week and the spring and fall seasons were associated with higher number of suicide attempts reported to U.S. poison centers. New Year's Day had a higher number of suicide attempts when compared to control days, although other holidays had no effect or had fewer attempts. This is similar to previous studies on completed suicides and smaller poison center-based studies suggesting that similar individual and environmental factors are involved between suicide attempt by poisoning and completed suicide.

### **4. How is patient care impacted?**

These results have implications for clinicians advising potential victims and providing emergency care for these patients.