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Nurse suicide in the United States: Analysis of the Center for Disease Control 2014 National Violent Death Reporting System dataset☆

Judy E. Davidson[a,b,*], James Proudfoot[c], Kelly Lee[d], Sidney Zisook[b]

[a] University of California San Diego Health, United States of America
[b] University of California San Diego School of Medicine, Department of Psychiatry, United States of America
[c] Clinical Translational Research Institute, University of California San Diego, United States of America
[d] University of California San Diego, Skaggs School of Pharmacy and Pharmaceutical Sciences, United States of America

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ABSTRACT

Objective: This study explored nurse suicide in the United States.
Methods: Characteristics were compared between occupations using 2014 National Violent Death Reporting System data.
Results: Female nurse suicides were significantly higher (11.97/100,000) than in the female population (7.58/100,000) ($p < 0.001$); similarly male nurses (39.8/100,000) compared to the male population (28.2/100,000) ($p < 0.001$). Benzodiazepines and opioids were the most commonly used substances used in clinician suicide.
Conclusion: These results suggest a public health imperative for future research and development of effective preventative strategies for nurses; a largely understudied population.

Suicide rates are increasing globally ("Increase in suicide rates, 1999–2014", 2016; Lieberman, 2016) with about 800,000 people dying of suicide each year, making it the 17th leading cause of death worldwide in 2016 ("Community Engagement Kit", 2017; "Suicide", 2018; World Health Organization, 2014). Suicide is the 10th leading cause of death in the United States (U.S.) with almost 45,000 deaths related to suicide yearly. The annual U.S. age-adjusted rate of suicide is 13.42 per 100,000 individuals (Last, Tufts, & Auger, 2017; Organizations & Hospital, 2007). Approximately 400 physicians complete suicide annually (Andrew, 2015). However, the incidence of nurse suicide in the United States is largely unchartered (Davidson, Stuck, Zisook, & Proudfoot, 2018). Outdated U.S. (Alston, 1986; Feskanich et al., 2002; Hawton & Vislisel, 1999; Katz, 1983; Stack, 1982, 2001) and more recent international literature (Alderson, Parent-Rocheleau, & Mishara, 2015; Andersen, Hawgood, Klieve, Kolves, & De Leo, 2010; Cheung & Yip, 2015, 2016; Hawton et al., 2002; Kolves & De Leo, 2013; Milner, Spittal, Pirkis, & LaMontagne, 2013; Milner, Maheen, Bismark, & Spittal, 2016; Tramutola, 2015) suggests that nurses are at higher risk of suicide than the general public.

As a pilot to refine the methodology for this study, we conducted a longitudinal retrospective review of nurse suicides in San Diego County between 2005 and 2014. Overall RN (18.51) and physician (40.72) incidence of suicide were higher than the general population excluding nurses (15.81) normalized to 100,000 person years. Nurse gender was available for only 2014. In that year female nurses were at a higher risk of suicide than females in the general population (10.41 vs. 7.41 per 100,000 person years). Although nurses completed suicide at a numerically higher rate (18.51) than the general public (15.81) normalized to 100,000 person years, we did not find a statistically significant difference in the two rates (Davidson, Stuck, et al., 2018).

The purpose of this study was to quantify the incidence, methods, and predictive factors of nurse suicide in the United States through retrospective correlational analysis of the National Violent Death Reporting System (NVDRS) database for the year 2014.

Methods

Ethics

This project was excused from Investigational Review Board oversight as research on deceased individuals using a de-identified data set (#170165). The Centers for Disease Control and Prevention (CDC) department for the National Violent Death Reporting System (NVDRS) provided ethical oversight for use of this data.

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* Corresponding author at: University of California San Diego Health, United States of America.
E-mail address: jdavidson@ucsd.edu (J.E. Davidson).

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Denominators

Denominators for nurses were obtained from the National Council of State Boards of Nursing website (https://www.ncsbn.org/6161.htm) access date 7/16/2017 for all states excluding Oklahoma, which does not report to the national database. Oklahoma nursing denominators were obtained from the Oklahoma Board of Nursing website (http://nursing.ok.gov/pubs.html) access date 7/16/2017. Denominators represent active licensed practitioners (not necessarily employed). Gender data were obtained (Budden, Moulton, Harper, Brunell, & Smiley, 2016). Of note, nurse gender data are generated from surveys conducted periodically over time. There were published data for 2013 (Budden, Zhong, Moulton, & Cimiotti, 2013) and 2015 (Budden et al., 2016) but not 2014. We retrieved the unpublished estimated survey data directly from the NCSBRN for the 18 states represented in the NVDRS dataset to generate an estimated average of 7% male. The denominator was age matched for suicides from the general population of people aged 20 and older. We confirmed that age of entry of nurses into the profession with the National Councils of State Boards of Registered Nursing.

NVDRS/sample

The NVDRS is a restricted dataset provided by the Center for Disease Control and Prevention. Unlike the general mortality statistics, it is coded by occupation. The 2014 dataset contained all suicides reported by medical examiners from 18 states (Electronic supplement S1).

Occupation codes

Though the NVDRS is constructed to be coded by occupation using occupation codes from death certificates, this field was found to be universally left blank. However, the occupation had been entered free text into the database. Using iterative manual natural language processing, two investigators analyzed the free text fields. First, the occupation column was sorted alphabetically, then the search function was with 'nur', 'RN'. Next, the column was scanned row by row to detect other derivatives of the terms. The final list was critiqued by the other members of the research team (Electronic supplement S2).

Data analysis

Victim characteristics were compared between each occupation group (nurse vs. other) with Fisher's exact test for categorical variables and a two-sample *t*-test for continuous variables (i.e. number of crises). Conditional maximum likelihood estimates of odds ratios and their 95% confidence intervals (CI) were calculated for binary categorical characteristics. Incidence rates for each occupation of interest are reported in units of 100,000 person-years. Incidence rate ratios (IRR) and associated 95% Wald confidence intervals were computed. A chi-squared test was used to test for differences in exposed and non-exposed proportions for each stratum, with exposure defined by medical profession and/or gender. Homogeneity of IRR's across strata was tested using the Breslow-Day test.

Results

Demographics

Characteristics of subjects including sex, age, body mass index (BMI), race, and ethnicity are found in Table 1. Denominator counts of the general population are found in Electronic supplement S3. In 2014 in the 18 states included in the dataset there were 14,774 suicides, of which there were 205 nurses.

Table 1
Characteristics of subjects from the NVDRS database for 2014.

	Occupation		Overall	p-Value
	Nurse	Other		
Sex	n = 205	n = 14,504	n = 14,709	
Female	164 (80.0%)	3210 (22.1%)	3374 (22.9%)	< 0.001***
Male	41 (20.0%)	11,294 (77.9%)	11,335 (77.1%)	
Age	n = 205	n = 14,503	n = 14,708	
	51.13 (12.64)	46.67 (18.33)	46.73 (18.27)	< 0.001***
BMI	n = 139	n = 9485	n = 9624	
	27.27 (7.19)	26.79 (6.14)	26.79 (6.16)	0.431
Race	n = 205	n = 14,368	n = 14,573	
American Indian	1 (0.5%)	194 (1.4%)	195 (1.3%)	0.430
Asian/PI	4 (2.0%)	256 (1.8%)	260 (1.8%)	
Black	9 (4.4%)	933 (6.5%)	942 (6.5%)	
Other	0 (0.0%)	169 (1.2%)	169 (1.2%)	
Two or more	1 (0.5%)	112 (0.8%)	113 (0.8%)	
White	190 (92.7%)	12,704 (88.4%)	12,894 (88.5%)	
Ethnicity	n = 205	n = 14,413	n = 14,618	
Hispanic	3 (1.5%)	692 (4.8%)	695 (4.8%)	0.020*
Non-Hispanic	202 (98.5%)	13,721 (95.2%)	13,923 (95.2%)	

* = statistically significant.

Suicide method

The method of suicide varied between nurses and others. The most common method in nurses was poisoning by pharmaceuticals. In contrast, in the general population, the most common method was firearms (Table 2). Substances listed as cause of death were diverse in nature, and did not cluster to a specific classification. Further, opioids, benzodiazepenes and antihistamines were the most common classes of medications attributed to cause of death found in the toxicology screens of nurses who completed suicide (Electronic supplement S4).

Incidence

The incidence rate of suicides in nurses (male and female) was 13.9 per 100,000 person-years compared to 17.7 per 100,000 person-years in the general population (ages 20+). The IRR was 0.79 with 95% CI 0.68 to 0.90 ($p < 0.001$). The incidence rate of suicides in female nurses was 11.97 per 100,000 person-years, and 7.58 per 100,000 person-years in the female general population (ages 20+), for an IRR between female nurses and the female general population (age 20+) of 1.58 (95% CI: 1.34 to 1.85, $p < 0.001$). The incidence rate of suicides in male nurses was 39.8 per 100,000 person-years compared to 28.2 per 100,000 person-years in the male general population (ages 20+). The IRR between male nurses and the male general population (age 20+) is 1.41 (95% CI: 1.01 to 1.91, $p = 0.028$). The incidence rate of suicides in female nurses was significantly lower than in male nurses (11.97 per 100,000 person-years in female nurses vs. 39.8 per 100,000-person years in male nurses (IRR = 0.30 (95% CI: 0.21 to 0.43, $p < 0.001$)). The incidence rate of suicides in females in the general population was 7.58 per 100,000 person-years vs. 28.23 per 100,000 person-years in males in the general population (IRR = 0.27 (95% CI: 0.26 to 0.28, $p < 0.001$)). The male:female suicide ratios in nurses was 3.32:1 compared to3.72:1 in the general population. There was no evidence of non-homogeneity between the female and male IRR in the nurse population and non-nurse population ($p = 0.515$).

Mental health and social risk factors for nurses vs. the general population are provided (Table 3). Nurses were statistically significantly more likely to have reported mental health problems, history of a

Table 2
Suicide method by occupation, NVDRS database for 2014

Method	Occupation				Overall (n = 14,774)
	Nurse (n = 205)	Physician (n = 50)	Pharmacist (n = 15)	Other (n = 14,504)	
Firearm	69 (33.7%)	29 (58.0%)	5 (33.3%)	7464 (51.5%)	7567 (51.2%)
Hanging, strangulation, suffocation	28 (13.7%)	8 (16.0%)	4 (26.7%)	3954 (27.3%)	3994 (27.0%)
Poisoning (Pharm.)	72 (35.1%)	5 (10.0%)	2 (13.3%)	1319 (9.1%)	1398 (9.5%)
Poisoning (Other)	26 (12.7%)	4 (8.0%)	3 (20.0%)	818 (5.6%)	851 (5.8%)
Sharp instrument	5 (2.4%)	2 (4.0%)	0 (0.0%)	258 (1.8%)	265 (1.8%)
Fall	4 (2.0%)	1 (2.0%)	1 (6.7%)	253 (1.7%)	259 (1.8%)
Drowning	1 (0.5%)	1 (2.0%)	0 (0.0%)	123 (0.8%)	125 (0.8%)
Motor vehicle	0 (0.0%)	0 (0.0%)	0 (0.0%)	106 (0.7%)	106 (0.7%)
Other transport vehicle	0 (0.0%)	0 (0.0%)	0 (0.0%)	82 (0.6%)	82 (0.6%)
Fire or burns	0 (0.0%)	0 (0.0%)	0 (0.0%)	56 (0.4%)	56 (0.4%)
Unknown	0 (0.0%)	0 (0.0%)	0 (0.0%)	22 (0.2%)	22 (0.1%)
Other	0 (0.0%)	0 (0.0%)	0 (0.0%)	21 (0.1%)	21 (0.1%)
Blunt instrument	0 (0.0%)	0 (0.0%)	0 (0.0%)	20 (0.1%)	20 (0.1%)
Non-powder gun	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (0.0%)	5 (0.0%)
Explosives	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)	2 (0.0%)
Intentional neglect	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.0%)	1 (0.0%)

treatment of mental illness, history of previous suicide attempt, leaving a suicide note and physical health problems than the general population. Nurses were significantly less likely to have a recent criminal problem or alcohol problem than the general population.

Discussion

We failed to detect significance in nurses vs. the *overall* general population, explainable due to the higher proportion of females amongst nurses (Norton & Divine, 2015). More importantly, when taking gender into account, both male and female nurses were significantly greater risk of suicide than the gender and aged matched general population. The limitations on the data imposed by gender could be overcome by a larger sample size. The 2015 NVDRS dataset increases from 18 states to 40 states. We plan to replicate this study with that larger sample.

The findings amongst nurses are congruent with our previous pilot of nurse suicides in San Diego in that *female* nurses were higher than the female general population to complete suicide in this same year (Davidson, Stuck, et al., 2018), and given the larger sample size the difference was statistically significant in this study.

Perhaps even more clinically meaningful than the findings related to the relative incidence of suicide amongst nurses, this investigation begins to inform us of methods of suicide and risks associated with suicide that are specific to the profession of nursing. The findings are congruent with our previous San Diego pilot reporting nurses most commonly use pharmaceutical poisoning while physicians and the general population most commonly complete suicide by firearms (Davidson, Stuck, et al., 2018). We hope in the future to be able to use qualitative research methods coupled with natural language processing to analyze the law enforcement and medical examiner free text fields for a more complete analysis of suicide risks. That significantly more nurses had reported previous mental health treatment and previous attempts and were still successful at completing suicide suggests that mental health issues may have been undertreated. This is congruent with our findings from the pilot of a nurse suicide prevention program where high risk nurses, including those with previous attempts, reported continued depression and suicidal ideation despite past treatment (Davidson, Zisook, Kirby, DeMichele, & Norcross, 2018).

Manually coding the occupation, though at first seen as a limitation, provided information about the types of nurses who completed suicide that would not otherwise have been available. If the dataset had been used as designed we would only have known that the suicide had been completed by a nurse. From the free text descriptions it is clear that in 2014 in these states nurse anesthetists and retired nurses were at higher risk than other nurses (Electronic supplement S2). These potentially important yet unanticipated findings bear further exploration with larger, hypothesis-driven studies.

Nurses completed suicide more commonly by poisoning using pharmaceuticals and other substances, followed closely by firearms, where all others completed suicide most commonly by firearms. This is similar to our San Diego findings (Davidson, Stuck, et al., 2018). There has been debate whether the use of medications in healthcare clinician suicide represents risks associated with access in the workplace vs. knowledge of lethality of medications. The substances identified as cause of death in nurse suicide contain a combination of medications used only in the hospital setting (e.g.: succinylcholine, phenobarbital) as well as those commonly found in the home (e.g.: oxycodone, ibuprofen). This differs from the San Diego pilot, where the drugs implicated in cause of death were universally medications available in the home (Davidson, Stuck, et al., 2018). Benzodiazepines, antihistamines and opioids were the most common agents implicated in cause of nurse death, validating the need to address substance use, pain, and mental health issues that may lead to medication misuse within the workforce. The dangers of concomitant use of benzodiazepines and opioids have been previously published ("Benzodiazepines and Opioids. National Institute on Drug Abuse", 2018; Dasgupta et al., 2016; Gomes, Mamdani, Dhalla, Paterson, & Juurlink, 2011) and this analysis suggests that healthcare clinicians are not immune to toxicity from these agents. Interestingly, common substances of abuse such as alcohol, marijuana or illicit substances were not found in this study of nurses. This quantitative analysis taken without context cannot answer the question of access vs. knowledge at this time. We plan a more in-depth analysis of this data in a future study pairing the qualitative data provided by law enforcement and medical examiners with the coded demographic variables to explore substance use in healthcare clinician suicide in greater detail.

Limitations

Before fully embracing this study's findings, certain caveats must be considered. First, this is a one year cross-section of data. Suicide rates fluctuate from year to year. Due to the fluctuation in incidence of suicide from year to year a longitudinal analysis is planned and warranted. Second, the dataset contained suicides from only 18 states, and may reflect geographic variation. As data become available the study will be replicated with more states represented. Third, the gender demographic data for nursing was derived from the best available sampling methodology but could be improved with actual workforce data. Finally, manual detection of occupation codes was a limitation. We retained

Table 3
Mental health and other characteristics for nurses and other occupations (not including nurses, physicians, or pharmacists) from the NVDRS database for 2014 (only including subjects who are at least 20 years old).

	Occupation		p-Value	Odds ratio
	Nurse (n = 205)	Other (n = 13,645)		
Mental health problems				
No	93 (45.4%)	7749 (56.8%)	0.001**	0.632 (0.474, 0.841)
Yes	112 (54.6%)	5896 (43.2%)		
Depressed mood				
No	129 (62.9%)	9097 (66.7%)	0.264	0.849 (0.633, 1.145)
Yes	76 (37.1%)	4548 (33.3%)		
Mental illness treatment current				
No	124 (60.5%)	10,186 (74.7%)	< 0.001***	0.520 (0.389, 0.699)
Yes	81 (39.5%)	3459 (25.3%)		
History mental illness treatment				
No	114 (55.6%)	9230 (67.6%)	< 0.001***	0.599 (0.450, 0.800)
Yes	91 (44.4%)	4415 (32.4%)		
Alcohol problems				
No	185 (90.2%)	11,323 (83.0%)	0.005**	1.897 (1.190, 3.185)
Yes	20 (9.8%)	2322 (17.0%)		
Substance abuse				
No	169 (82.4%)	11,656 (85.4%)	0.232	0.801 (0.554, 1.186)
Yes	36 (17.6%)	1989 (14.6%)		
Intimate partner problem				
No	154 (75.1%)	10,127 (74.2%)	0.810	1.049 (0.758, 1.473)
Yes	51 (24.9%)	3518 (25.8%)		
Relationship problem				
No	203 (99.0%)	13,410 (98.3%)	0.589	1.779 (0.481, 14.875)
Yes	2 (1.0%)	235 (1.7%)		
Interpersonal violence perp.				
No	203 (99.0%)	13,316 (97.6%)	0.247	2.508 (0.680, 20.934)
Yes	2 (1.0%)	329 (2.4%)		
Interpersonal violence victim				
No	205 (100.0%)	13,598 (99.7%)	1.000	*Inf* (0.183, *Inf*)
Yes	0 (0.0%)	47 (0.3%)		
Argument				
No	176 (85.9%)	11,806 (86.5%)	0.757	0.945 (0.633, 1.457)
Yes	29 (14.1%)	1839 (13.5%)		
Circumstances known				
No	13 (6.3%)	1307 (9.6%)	0.149	0.639 (0.333, 1.123)
Yes	192 (93.7%)	12,338 (90.4%)		
Precipitated by other crime				
No	203 (99.0%)	13,224 (96.9%)	0.098	3.231 (0.878, 26.951)
Yes	2 (1.0%)	421 (3.1%)		
Other crime in progress				
No	204 (99.5%)	13,543 (99.3%)	1.000	1.536 (0.267, 61.570)
Yes	1 (0.5%)	102 (0.7%)		
Terrorist attack				
No	205 (100.0%)	13,645 (100.0%)	–	
Suicide attempt history				
No	149 (72.7%)	11,229 (82.3%)	< 0.001***	0.572 (0.417, 0.796)
Yes	56 (27.3%)	2416 (17.7%)		
Suicide intent disclosed				
No	157 (76.6%)	10,644 (78.0%)	0.611	0.922 (0.662, 1.306)
Yes	48 (23.4%)	3001 (22.0%)		
Suicide note				
No	114 (55.6%)	9525 (69.8%)	< 0.001***	0.542 (0.407, 0.724)
Yes	91 (44.4%)	4120 (30.2%)		
Recent criminal legal problem				
No	199 (97.1%)	12,494 (91.6%)	0.002**	3.055 (1.375, 8.444)
Yes	6 (2.9%)	1151 (8.4%)		
Legal problem (other)				
No	197 (96.1%)	13,261 (97.2%)	0.390	0.713 (0.351, 1.687)
Yes	8 (3.9%)	384 (2.8%)		
Physical health problem				
No	149 (72.7%)	10,808 (79.2%)	0.030*	0.698 (0.509, 0.970)
Yes	56 (27.3%)	2837 (20.8%)		
Job problem				
No	177 (86.3%)	12,231 (89.6%)	0.133	0.731 (0.487, 1.136)
Yes	28 (13.7%)	1414 (10.4%)		
Finance problem				
No	191 (93.2%)	12,362 (90.6%)	0.275	1.416 (0.820, 2.647)
Yes	14 (6.8%)	1283 (9.4%)		

(*continued on next page*)

Table 3 (*continued*)

	Occupation		p-Value	Odds ratio
	Nurse (n = 205)	Other (n = 13,645)		
School problem				
No	205 (100.0%)	13,592 (99.6%)	1.000	*Inf* (0.207, *Inf*)
Yes	0 (0.0%)	53 (0.4%)		
Recent suicide (friend/family)				
No	199 (97.1%)	13,402 (98.2%)	0.188	0.601 (0.268, 1.675)
Yes	6 (2.9%)	243 (1.8%)		
Death (friend/family/other)				
No	189 (92.2%)	12,894 (94.5%)	0.163	0.688 (0.410, 1.235)
Yes	16 (7.8%)	751 (5.5%)		
Crisis recently				
No	198 (96.6%)	13,249 (97.1%)	0.672	0.845 (0.399, 2.144)
Yes	7 (3.4%)	396 (2.9%)		
Other addiction				
No	205 (100.0%)	13,566 (99.4%)	0.634	*Inf* (0.313, *Inf*)
Yes	0 (0.0%)	79 (0.6%)		
Family relationship				
No	186 (90.7%)	12,561 (92.1%)	0.438	0.845 (0.523, 1.441)
Yes	19 (9.3%)	1084 (7.9%)		
Death abuse				
No	205 (100.0%)	13,638 (99.9%)	1.000	*Inf* (0.022, *Inf*)
Yes	0 (0.0%)	7 (0.1%)		
Abused as child				
No	203 (99.0%)	13,509 (99.0%)	1.000	1.022 (0.274, 8.581)
Yes	2 (1.0%)	136 (1.0%)		
Fight between two people				
No	205 (100.0%)	13,574 (99.5%)	0.629	*Inf* (0.281, *Inf*)
Yes	0 (0.0%)	71 (0.5%)		
Stalking				
No	204 (99.5%)	13,639 (100.0%)	0.099	0.090 (0.011, 4.148)
Yes	1 (0.5%)	6 (0.0%)		
Prostitution				
No	205 (100.0%)	13,643 (100.0%)	1.000	*Inf* (0.003, *Inf*)
Yes	0 (0.0%)	2 (0.0%)		
Walk by assault				
No	205 (100.0%)	13,645 (100.0%)	–	
Suicide thought history				
No	130 (63.4%)	9768 (71.6%)	0.012*	0.688 (0.513, 0.929)
Yes	75 (36.6%)	3877 (28.4%)		
Eviction or loss of home				
No	198 (96.6%)	13,200 (96.7%)	0.842	0.954 (0.451, 2.417)
Yes	7 (3.4%)	445 (3.3%)		
Traumatic anniversary				
No	203 (99.0%)	13,568 (99.4%)	0.327	0.576 (0.152, 4.875)
Yes	2 (1.0%)	77 (0.6%)		
Disaster exposure				
No	205 (100.0%)	13,633 (99.9%)	1.000	*Inf* (0.041, *Inf*)
Yes	0 (0.0%)	12 (0.1%)		
Number of crises	0.35 (0.67)	0.39 (0.67)	0.330	
Any crisis				
No	152 (74.1%)	9444 (69.2%)	0.147	1.276 (0.925, 1.783)
Yes	53 (25.9%)	4201 (30.8%)		

* = statistically significant.

'retired' clinicians in the counts because nurses are known to keep their licenses into retirement, and the denominator of nurses was 'actively licensed'. It is possible that this could have biased the results in either direction. It would not have been possible to cleanly remove retired nurses from either the NVDRS or the demographic dataset. We determined that the risk of bias was less by leaving them included than the risk of inaccurately removing them.

Conclusion

In conclusion, nurses were at higher risk than the age and gender matched controls to complete suicide. Nurses were more likely to complete suicide by pharmaceutical poisoning; the general population most commonly used firearms. Confidence in results would be improved if workforce gender data were available in nursing to conduct between gender-specific analyses. Results suggest that both female and male nurses may be at risk of suicide as has been found internationally. Future research is planned with a larger sample and longitudinal study design.

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