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Physician Suicide in the United States: Updated Estimates from the National Violent Death Reporting System

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ABSTRACT

Physician suicide and well-being are critical issues but studies use varying methodologies and suicide is frequently underreported. This study sought to update data on physician suicides in the United States. The National Violent Death Reporting System (NVDRS) at the Centers for Disease Control collects details about violent deaths. The study used 2010–2015 data from 27 NVDRS states to identify suicide deaths among physicians or non-physicians and calculate annual standardized mortality rates (SMR). Of 63,780 victims total, there were 357 physicians identified over 6 years, (307 men and 50 women). If results are extrapolated to all 50 states, there would be approximately 119 physician suicides annually. The SMR for physicians overall was not statistically different from that of non-physicians. This is the first study in 16 years to update estimated physician suicide rates in the United States. The research used strict criteria to identify physicians so results likely represent the lower boundary of physician suicides. Findings show that physician suicide is not significantly lower than that of non-physicians and emphasizes the importance of focusing on structural changes to reduce stigma around mental health in the medical community.

Introduction

Physician suicide is often seen as a particularly tragic event because it occurs in a population with seemingly good access to resources and medical care. Media coverage has focused on the need to reduce stigma so as to enhance treatment and prevention. Medical organizations (American Foundation for Suicide Prevention (Producer), 2018), including the National Academy of Medicine (National Academy of Medicine, 2017), the American Medical Association (Murphy, 2018), and the Federation of State Medical Boards (Federation of State Medical Boards, 2018b) have begun to address issues of physician well-being, including both burnout and mental health. However, estimates of the incidence and prevalence of physician suicide are usually based solely on death certificates, from older studies, and from populations outside the United States. (Schernhammer & Colditz, 2004)

The usual estimate quoted in literature and media reports is that 300–400 physicians in the United States die by suicide annually (American Foundation for Suicide Prevention (Producer), 2018). This figure appears to come from an expert panel meeting in 2002, although it was not explicitly published by the panel (Center et al., 2003). The most comprehensive meta-analysis of global literature on this topic (Schernhammer et al., 2004) reported higher suicide rate ratios for male physicians (1.41) and female physicians (2.27) compared with the general population. However, the review analyzed data collected from 1935 to 1998 so may not reflect current experience and most studies were not U.S.-based. More recent epidemiological studies (all from outside the U.S.) have been conflicting. Some documented higher rates of physician deaths by suicide (Hawton et al., 2011), others found higher risk only in subgroups such as female or older physicians (Skegg et al., 2010), and some report no increased risk at all (Petersen & Burnett, 2008).

The National Violent Death Reporting System (NVDRS) is managed by the Centers for Disease Control and collects and reports details about violent deaths.(Centers for Disease Control and Prevention, 2019) NVDRS links information from death certificates, law enforcement reports, coroner, and medical examiner reports and toxicology data. Such integrated data makes it easier to identify cause of death and to understand the circumstances, precipitants, and risk factors. We used occupational information within NVDRS to identify physicians and analyzed age- and gender-normalized standardized mortality ratios for suicides among physicians versus the non-physician general population. We extrapolated from participating states to the U.S. to estimate the average number of physician suicides nationally.

Methods

Data

We used data from NVDRS to identify all deaths by suicide for the years 2010 through 2015.

Our cohort included deaths from 27 states (Online Supplement, Appendix A). Of these, 16 states reported data from all 6 years (Alaska, Colorado, Georgia, Kentucky, Maryland, Massachusetts, New Jersey, New Mexico, North Carolina, Oklahoma, Oregon, Rhode Island, South Carolina, Utah, Virginia, and Wisconsin). One state reported data for 2011–2015 (Ohio), one state for 2014–2015 (Michigan), and nine states for 2015 only (Arizona, Connecticut, Hawaii, Kansas, Maine, Minnesota, New Hampshire, New York, and Vermont). All states now participate in NVDRS, but their data was not available at the time of analysis. We excluded the 13% of deaths in our initial cohort classified as 'unable to determine manner of death' where there was insufficient evidence to determine if the injury was intentional. We also excluded individuals less than age 27, since most physicians are at least 27 by graduation. (Federation of State Medical Boards, 2018a)

Occupation

To identify physicians, we examined two fields coded from the U.S. Death Certificate for occupation and industry, three free-text fields for current and usual occupation, and four

free-text fields with longer narratives about the circumstances surrounding the death as these narratives sometimes mentioned the victim's occupation or job. Physicians were identified by searching text fields using 91 separate terms, e.g.: 'physician,' 'cardiol*,' or 'doctor*.' (Online Supplement, Appendix B). In all cases, we read the full narrative to ensure the victim was indeed a physician. 'The victim was a retired physician' was coded as a match but 'The victim did not have a primary care physician' was not.

We separately identified non-physicians. This included victims in all other occupations, 'students' or 'homemakers' without specific reference to any other occupation, and those who 'never worked' with supportive narrative (e.g., lifelong disability). Victims listed as disabled, unemployed, retired, not working, or imprisoned were retained as long as we could identify the victim's usual or previous occupation. If no occupation could be determined, we excluded the case from analysis. In a few specific states/years within the NVDRS dataset, 50% or more of individuals could not be identified as either physicians or non-physicians and these were removed from the analysis. This included Kentucky in 2010, New Jersey in 2011, 2012, and 2013, and South Carolina in 2013 and 2014. All other states had 12% or less missing occupational data.

Population

To identify the baseline population of physicians in the United States, we extracted data from yearly publications by the American Medical Association (AMA) showing total physician population in the country by gender, state, and age category.(American Medical Association, 2012, 2013, 2014, 2015) This data is sourced from the AMA Physician Masterfile and includes all physicians, both active and inactive, in the United States. We retained data for inactive physicians since they are still at risk for suicide. As the AMA had only released data through 2013, we calculated the average rate of change from 2010 to 2013 by state, gender, age, and active versus inactive status and extrapolated that rate of change to estimate physician population for 2014 and 2015. AMA includes several age categories: <35, 35–44, 45–54, 55–64, ≥65. We set minimum age of 27 to exclude potential medical students. Data from the Federation of State Medical Boards demonstrated the physicians ages 23 to 26 represented less than 1000 (0.1%) people in the total physician population.(Federation of State Medical Boards, 2018a) We subtracted physicians under age 27 by gender and state to achieve a 27–35 age category.

To estimate the U.S. population, we used data from CDC Wonder which is based on the US Census and provides yearly population estimates from the U.S. Census separated by state, age, and gender.(Centers for Disease Control, 2018) We extracted the data for individuals 27 and older, for 2010–2015 across all 50 states and the District of Columbia. We then subtracted the physician population from the general population to identify non-physicians in the general population.

Standardized mortality ratio

Most studies of suicide mortality by occupation use a ratio to compare deaths by suicide with deaths from other causes (Schernhammer & Colditz, 2004). Since our dataset only included suicides, it was more appropriate to calculate a Standardized Mortality Ratio (SMR) to show the observed number of physician suicides compared with the expected

number (based on suicide deaths among the general population), adjusted by age and gender. If SMR equals one, this indicates that observed deaths (the numerator) is the same as the expected number of deaths (the denominator). If SMR is greater than one, there are more observed deaths than would be expected. We used suicide data for 2010–2015 and created strata using age categories (27–35, 35–44, 45–54, 55–64, 65 and older), separated by year and gender. The age categories were chosen to match the publicly available physician population data from AMA.

To calculate the expected number of physician suicides, we identified the number of physician suicides for each gender, year, and age category. For example, for men 27–34, in the states included in the 2010 NVDRS cohort:

$$Expected\ suicides\ 27-34 = \frac{(Observed\ general\ population\ suicides\ 27-34)}{General\ population\ 27-34} * Physician\ pop.\ 27-34$$

The formula is based on simple binomial count assumption. This process was repeated for all five age categories, all 6 years, and for men and women. To calculate the overall SMR for 2010, we divided the observed number of male physician suicides in 2010 from our NVDRS cohort by the expected number of suicides across all five age groups. For example, for male physicians in 2010:

$$\frac{SMR\ 2010 = Actual\ 2010\ male\ physician\ suicides\ from\ NVDRS}{Expected\ 2010\ male\ suicides\ for\ ages\ (27-34)+(35-44)+(45-54)+(55-64)+(65+)}$$

This process was also repeated separately for each year and for female physicians.

To assess the margin of error associated with the SMR point estimates, we calculated 95% confidence intervals using the Mid-P exact method.(Rothman & Boice, 1979) There are several exact and approximate methods available for calculating such intervals. Exact methods are iterative and are based on the assumption that the observed number of suicides have a Poisson distribution. These methods are especially valid when the number of suicides is less than 10.

Total U.S. physician suicide estimates

To estimate annual physician suicides across the entire U.S., we divided total NVDRS male physician suicides by total male physician population from AMA data in the same states and multiplied by total U.S. male physician population. We divided the final number by six since our estimates combined 2010–2015. We repeated this calculation for female physicians.

Demographics, data analysis, and ethics approval

We calculated mean age, marital status, gender, and race for physicians and non-physicians. Race is reported here as 'white' or 'non-white' to protect confidentiality due to small sample size among subgroups. Age, race, gender, and marital status all had <1% missing data. Educational level was missing for more than a quarter of the cohort and was often miscoded (e.g., an individual clearly identified as a physician in the narrative but listed as having only a high school education) so was not used. Data were analyzed using

STATA 13.1 IC (College Station, TX). NVDRS requires that cells with five or fewer deaths be suppressed. The study was evaluated by the University of Michigan Institutional Review Board and determined to be not regulated as human subjects research since study subjects were deceased.

Results

Our full data set included 96,611 records (Figure 1). We excluded individuals for whom the manner of death was undetermined if suicide or homicide (n = 12,345), subjects under age 27 (n = 13,940), those without any identifiable occupation (n = 5413), and data from the three states with years containing an identified occupation for less than half their victim cohort (n = 1133). This left 63,422 subjects for analysis of whom 357 were identified as physicians. More older individuals died by suicide, both physicians (Figure 2) and non-physicians.

Physicians in the NVDRS dataset were more likely than the general population in the data set to be male (86% versus 77%, p < 0.0005), older (60 versus 52 years, p < 0.0005) and married (58% versus 40%, p < 0.0005). (Table 1)

Suicide standardized mortality ratios (SMR) are listed in Table 2. For 2010, the SMR for men was 0.81 indicating a 19% lower risk of suicide for male physicians versus non-physicians and the SMR for women in 2010/2011 (combined due to sample size) was 1.26 suggesting a 26% higher risk for suicide; however, neither was statistically significant. The overall number of suicides are quite small among women physicians, which is reflected in the wider confidence intervals showing more uncertainty in the point estimates. Similar SMR calculations were done for each subsequent year through 2015.
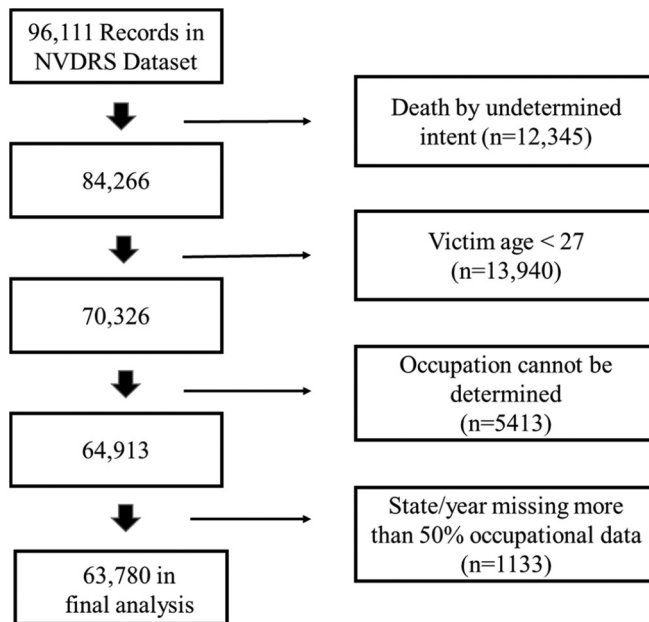

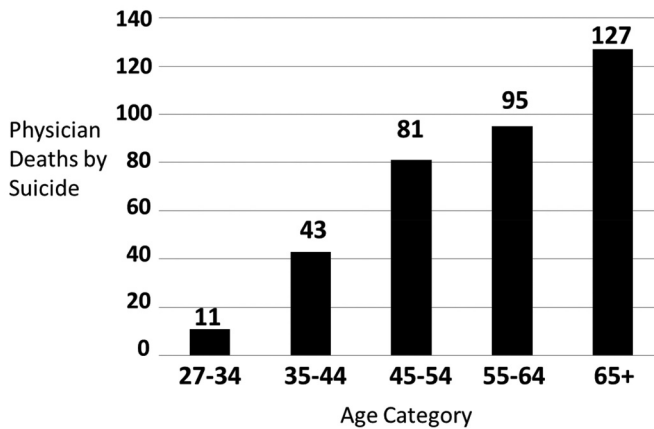**Figure 1.** Description of NVDRS study cohort for analysis.

Figure 2. Physician deaths by suicide from 2010–2015 in NVDRS cohort by age category (*n* = 357). Men and women combined due to small cell size in some categories.

Table 1. Demographics and characteristics for suicides in NVDRS cohort, ages 27 and older. Total number of states varies by year.

	Physician: *n*, % (*n* = 357)		Non-physician: *n*, % (*n* = 63,423)		*p*-value
Gender					
–Male	307	86	48,757 14,659	77	*p* < 0.0005
–Female	50	14		23	
Mean age[a]					
(±SD years)	60	±15	52	±15	*p* < 0.0005
Race	317	89	57,444	91	*p* = 0.252
–White	40	11	5979	9	
–Non-white					
Marital Status					
–Married	207	58	25,333 37,474	40	*p* < 0.0005
–Single	149	42		60	
Year	Men	Women	Men	Women	–
–2010	37		6304	1816	
–2011	42	19a	7169	2087	
–2012	41	7	7445	2229	
–2013	44	8	7100	2122	
–2014	51	9	8521	2593	
–2015	92	7	12 218	3811	

[a]2010 and 2011 combined for women due to small cell size

As SMR calculations are very responsive to sample size, we used 2015 data to conduct some additional exploratory analyses by increasing the number of male or female physician suicides up to 10 people. This resulted in significant changes in SMR (details on request).

To estimate total U.S. physician suicides, we extrapolated from physician population in our study to the physician population in the U.S. We used average annual number of male (51.2) and female (8.3) physician suicide deaths from the NVDRS data. If one uses a broad assumptions that states in the dataset are representative of the entire U.S. (the gender split in NVDRS states is similar to the U.S. as a whole per AMA) (American

Table 2. Physician standardized mortality ratio by year and gender, age adjusted.

Male Physicians					Female Physicians				
Male observed suicides	Male expected suicides	Male SMR	Male CI		Female observed suicides	Female expected suicides	Female SMR	Female CI
Total n = 307					n = 50				
37	45.80	0.81	0.58, 1.10	**2010–2011**[a]	19	15.07	1.26	0.78, 1.93
42	51.06	0.82	0.60, 1.10					
41	53.95	0.77	0.55, 1.02	**2012**	7	8.46	0.83	0.36, 1.64
44	52.19	0.84	0.62, 1.12	**2013**	8	8.12	0.99	0.46, 1.87
51	60.52	0.84	0.63, 1.10	**2014**	9	9.64	0.93	0.45, 1.71
92	93.09	0.99	0.80, 1.21	**2015**	7	15.08	0.46	0.20, 0.92

(Row year labels for Male section: **2010**, **2011**, **2012**, **2013**, **2014**, **2015**)

[a] 2010–2011 for women combined due to small cell size

Medical Association, 2015), there would be approximately 119 identified physician suicides each year (104 males, 15 females).

Discussion

This is the first estimate of Standardized Mortality Ratios showing death by suicide among U.S. physicians based on current and detailed multi-source death data. Overall, the study found no significant differences in suicide ratios for physicians versus non-physicians. In 2015, female physicians had a statistically significant lower risk than non-physicians.

We consider our findings the minimum estimate of physician SMR. While NVDRS data is the most comprehensive U.S. data set to identify circumstances surrounding violent deaths, we set strict criteria to label individuals as physicians only when there was absolutely clear evidence of this role. For example, a 'medical researcher' or 'clinic director,' might be a physician, but without confirmatory evidence, we did not classify them as such. This was a deliberate methodologic choice to prevent overestimation of physician deaths by suicide but means our numbers must be considered the minimum rate.

Concern for high rates of physician suicide is long-standing (Emerson & Hughes, 1926). In the United States, early estimates were based on records from the American Medical Association (which appear to have used death certificates to identify cause of death) as well as public obituaries published in JAMA (Blachly et al., 1968; Dublin & Spiegelman, 1947; Emerson & Hughes, 1926). While early studies focused on white males (most physicians at that time), by the 1960s and 1970s, researchers were reporting higher suicide rates in female physicians, compared to both male physicians and the general female population.(Ross, 1971)

There has been long-standing speculation that physician suicides are particularly likely to be concealed on death certificates due to social standing and stigma.(Margolis, 1968) Early researchers suggested that many of the JAMA-recorded deaths without a listed cause may actually be unreported suicides.(Craig & Pitts, 1968) A 1926 study noted New York City physician death certificates had a higher rate of undetermined/ill-defined deaths compared with the general population and condemned the lack of accuracy in certifying physician deaths (Emerson & Hughes, 1926). Coroners may be less likely to declare a physician death to be a suicide due to stigma, although this has not been formally measured. In a meta-analysis, half of suicide studies found more than 10% underreporting and almost 40% found more than 30% underreporting.(Tollefsen et al., 2012)

A strength of NVDRS is the data linkage among multiple sources to better corroborate cause of death. There is still underreporting by method; gunshot and hanging deaths in NVDRS were more likely to be assumed to be suicides than drug intoxication deaths, which often lacked information about co-morbid mental illness or a suicide note (Rockett et al., 2018). Drug fatalities were often listed as 'undetermined' manner of death. We excluded death by 'undetermined' cases as 'undetermined' deaths in one state may be classified as suicide in another, and drug overdoses may be classified as 'undetermined' in some states but not even included in NVDRS reporting in others. (Breiding & Wiersema, 2006) Excluding these deaths likely underreports suicides but it is

challenging to ascertain the exact number which are misclassified due to methodological variations at the state level.

It is difficult to compare our findings with studies from other countries which show both higher(Aasland et al., 2001; Hawton et al., 2011) and lower(Skegg et al., 2010) risk of suicide among physicians. A U.S. study using 1984–1992 data calculated a higher rate in white female and older white male physicians but limited the analysis to working adults. (Petersen & Burnett, 2008) Others reported the highest suicide rates among occupations requiring the least education and skill.(Milner et al., 2013; Mustard et al., 2010) Different referent groups can have a marked impact on results.(Mustard et al., 2010) A 2004 meta-analysis, included few studies from the U.S., and most studies compared suicides to other causes of death, essentially identifying the rate ratio which is different from SMR or incidence (Schernhammer & Colditz, 2004). At baseline, we would expect a working population to have better baseline health than the general population which includes individuals too sick to be employed.(McMichael, 1976)

Limitations

Our analysis has several limitations. Results likely represent the minimum number of physician suicides, as we were conservative in defining physician occupation. NVDRS currently collects data from all 50 states but this was not true during our study, and extrapolating nationally may not be accurate. While the NVDRS offers enlightening details about physician suicide risks and comorbidities, such analyses are beyond the scope of this manuscript. We used quantitative and free-text variables for occupation, but many were coded as unknown, requiring detailed searches of text fields. It would be useful for future research to examine coding in a state by matching NVDRS records with physician licensing records to identify the precise level of under-coding of physician occupation. This might allow better analysis of deaths identified as 'undetermined' cause and deaths by drug overdoses without known intent.

Conclusions

This is the first study in 16 years to update estimates of physician suicide rates in the United States and demonstrated no significant differences in SMR for physician suicide compared with suicides in the general population. The study is limited by the conservative methods used to count a victim as a physician, emphasizing the need to repeat the analysis when the NVDRS has additional states represented and a larger cohort in the dataset. This analysis does support prior findings that female physicians are at higher risk for suicide than male physicians, and identifying both risk factors and preventative strategies will be critical going forward. Physician mental health and well-being remain critical issues within U.S. health care as suicide is a potentially preventable cause of death and the death of a single physician can impact thousands of patients.

Disclaimer (required by CDC)

This research uses data from NVDRS, a surveillance system designed by the Centers for Disease Control and Prevention's (CDC) National Center for Injury Prevention and

Control. The findings were based, in part, on the contributions of the 27 funded states and territories that collected violent death data and the contributions of the states' partners, including personnel from law enforcement, vital records, medical examiners/coroners, and crime laboratories. The analyses, results, and conclusions presented here represent those of the authors and not necessarily reflect those of CDC. Persons interested in obtaining data files from NVDRS should contact CDC's National Center for Injury Prevention and Control, 4770 Buford Hwy, NE, MS F-64, Atlanta, GA 30 341–3717, (800) CDC-INFO (232–4636).

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Appendix A   States and Years included in NVDRS Analysis where X indicates inclusion of the state in that data year. Years in gray excluded due to lack of data to identify occupation

	2010	2011	2012	2013	2014	2015
Alaska	X	X	X	X	X	X
Arizona						X
Colorado	X	X	X	X	X	X
Connecticut						X
Georgia	X	X	X	X	X	X
Hawaii						X
Kansas						X
Kentucky	X	X	X	X	X	X
Maine						X
Maryland	X	X	X	X	X	X
Massachusetts	X	X	X	X	X	X
Michigan					X	X
Minnesota						X
New Hampshire						X
New Jersey	X	X	X	X	X	X
New Mexico	X	X	X	X	X	X
New York						X
North Carolina	X	X	X	X	X	X
Ohio		X	X	X	X	X
Oklahoma	X	X	X	X	X	X
Oregon	X	X	X	X	X	X
Rhode Island	X	X	X	X	X	X
South Carolina	X	X	X	X	X	X
Utah	X	X	X	X	X	X
Vermont						X
Virginia	X	X	X	X	X	X
Wisconsin	X	X	X	X	X	X

Appendix B   Codes used to search free-text fields to identify physicians

In all cases, free text fields were searched with these codes and then the text was read in full context (and sometimes other variables examined as well) to see if the match clearly indicated that the victim's occupation was physician. If the text referred to a medical condition or a comment about the victim's own medical care, it was not considered a match. Since the free text fields included various spellings, we included some different spellings or abbreviations for the same specialties.

1	abuse	25	family	50	neuro*	75	rectal
2	adolesc*	26	forensic	51	nuclear	76	rehab*
3	aerospace	27	gastro*	52	obstet*	77	renal
4	allerg*	28	genet*	53	oncol*	78	resident
5	anesth*	29	genom*	54	ophth*	79	rheum*
6	behavioral	30	geriatr*	55	opth*	80	scientist
7	bladder	31	GI	56	ortho*	81	sleep
8	bone	32	gyn*	57	osteop*	82	spinal
9	cancer	33	hand	58	pain m*	83	sports
10	cardio*	34	heart	59	pain d*	84	surg*
11	colorec*	35	hemato*	60	pain p*	85	thoracic
12	critical	36	hepat*	61	pallia*	86	toxicol*
13	cytog*	37	hospice	62	pathol*	87	undersea
14	dermat*	38	hyperb*	63	pediatr*	88	urolo*
15	diabet*	39	immun*	64	pelvic	89	vascul*
16	diagnostic	40	infect*	65	phys*	90	woman
17	DO	41	intern*	66	physician	91	women
18	doc*	42	joint	67	plastic		
19	doctor	43	kidney	68	PMR		
20	ED	44	matern*	69	professor		
21	electroph*	45	MD	70	psychiatr*		
22	emerg*	46	medical	71	pulmo*		
23	endocr*	47	MFM	72	radiol*		
24	eye	48	nephrol*	73	reconstruc*		