Suicide poisoning mortality: a comparison of the national poison data system and centers for disease control national dataset

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ABSTRACT
The America's Poison Centres National Poison Data System (NPDS) is set up for the active surveillance of voluntarily reported poisoning cases in near real-time. The Centres for Disease Control and Prevention (CDC)'s Wide-ranging Online Data for Epidemiologic Research (WONDER) database is final national mortality data from state registries. We compared suicide poisoning deaths in both datasets from 2000 to 2020 and tested their relationship using a simple linear regression model. Mean annual suicide poisoning deaths during the review period were 699 (SD 145) in NPDS, and 6150 (SD 577) in WONDER. NPDS annual cases averaged 11% of cases recorded in WONDER (SD 2%; Range 8%–16%). The regression coefficient for the linear relationship between annual deaths recorded in both datasets was 0.18 (p-value<0.001, R^2=0.51). The rapidly available NPDS data on fatal self-poisoning may provide sentinel surveillance regarding self-poisonings, but do not reliably predict final national data on suicide poisoning.

BACKGROUND
Suicide remains among the top leading causes of death in the United States (U.S.) with poisoning being one of the major methods of suicide accounting for about 12% of all suicides in 2020; 28.6% in females and 7.8% in males respectively.[1 2] National rates of intentional self-poisoning steadily increased from 2000 through 2018 based on data from suicide-related exposure cases in America's Poison Centres National Poison Data System.[3 4] While clinical outcomes of intentional self-poisoning may range from little effect to death, suicide poisoning mortality continues to be of public health concern. Future research to address suicide poisoning mortality will rely on the timely availability and reliability of mortality data sources. The National Poison Data System (NPDS) maintains close to real time data on cases of self-poisonings reported to America's Poison Centres,[5] while data from the Centres for Disease Control and Prevention (CDC)'s Wide-ranging Online Data for Epidemiologic Research (WONDER),[6] even though not as quickly available, provide the "gold standard" for capturing suicide cases in the U.S. In this study, we compare the NPDS suicide poisoning mortality data to that in the CDC WONDER national database to know how well they correlate, and how closely the near real-time NPDS data might predict the final CDC data.

WHAT IS ALREADY KNOWN ON THIS SUBJECT
⇒ Surveillance and early identification of suicide outcomes are important for mental health research and practice but there is a lag in availability of vital statistics data on suicide.

WHAT THIS STUDY ADDS
⇒ Data on fatal suicide-related exposure cases from America's Poison Centres are updated in almost real time but may not accurately predict final national vital statistics data on suicide by self-poisoning.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY
⇒ Although rapidly available, fatal suicide exposures from NPDS should be interpreted with caution for predicting final vital statistics on suicide poisonings.

Databases
The NPDS data from cases voluntarily reported to all 55 U.S. Poison Centres for assistance with clinical management cover a wide array of substances reported from all U.S. states and territories, and include the reasons for overdoses and subsequent clinical outcomes including death.[5] The NPDS data are primarily gathered for clinical management of patients and the database incorporates comprehensive information from Poison Centres' follow-up calls to monitor case progress and medical outcome. Poison Centre staff enter case information electronically and these data are uploaded to the NPDS automatically.[7] The NPDS data are accrued continuously and provide close to real-time information.

The CDC WONDER provides national mortality and population data produced by National Centre for Health Statistics (NCHS) at the CDC.[6] Mortality information is collected by state registries and provided to the National Vital Statistics System. Data are based on death certificates for U.S. residents. These data provide final, comprehensive national vital statistics information on deaths and specific causes of death in the U.S. population.

METHODS
We compared national annual numbers of reported suicide poisoning deaths in NPDS to the annual number of suicide poisoning deaths in CDC WONDER from 2000 to 2020. We extracted data from these databases using the available query functions provided in the respective data platforms.

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Table 1 Mean suicide poisoning deaths per year in NPDS compared with CDC WONDER databases

	Suicide poisoning deaths in NPDS* Mean (SD)	Suicide poisoning deaths in WONDER† Mean (SD)	Percentage of suicide poisoning deaths in WONDER constituted by suicide poisoning deaths in NPDS % (SD)
Age			
06–19 years	33 (9)	140 (36)	24 (4)
20–29 years	85 (12)	596 (54)	14 (2)
30–39 years	115 (17)	1006 (104)	12 (2)
40–49 years	156 (26)	1596 (246)	10 (2)
50–59 years	148 (44)	1569 (336)	9 (2)
60–69 years	85 (43)	729 (281)	11 (2)
70–79 years	40 (22)	311 (93)	12 (3)
80+years	27 (11)	202 (36)	13 (3)
Sex			
Male	307 (55)	3257 (233)	9 (2)
Female	391 (94)	2892 (384)	13 (2)
Total	699 (145)	6150 (577)	11 (2)

*America's Poison Centers' National Poison Data System (NPDS).
†Centers for Disease Control and Prevention (CDC)'s Wide-ranging Online Data for Epidemiologic Research (WONDER).

In NPDS, we extracted human exposure cases from suspected suicide poisonings resulting in an outcome of death (verified fatality as a result of the exposure or direct complication of the exposure).[7] For CDC WONDER, we extracted fatalities from injuries resulting from suicide poisonings (ICD-10 codes X60-X69).[6 8] We further examined these deaths by gender and age. We plotted graphs to visualise the comparison of suicide poisoning deaths in each database and we tested the linear relationship between the number of deaths in the NPDS and CDC database using a simple linear regression model.

As a public health surveillance activity involving de-identified data, this analysis did not require Institutional Review Board oversight.[9]

RESULTS

The mean annual deaths from suicide poisoning during the review period were 699 [SD 145] in NPDS, and 6150 (SD 577) in CDC WONDER data, respectively (table 1, figure 1). Proportionally, NPDS annual case numbers averaged 11% of total suicide poisoning deaths recorded in WONDER for all ages (SD 2%; Range 8%–16%), the highest proportion by age group being 24% for 6–19 year-olds (SD 4%; Range 14%–32%) and the lowest proportion 9% (SD 2%; Range 6%–15%) for the 50–59 year-old age group. In terms of gender, NPDS female suicide poisoning deaths averaged 13% of female suicide poisoning deaths recorded in WONDER (SD 2%; Range 9%–19%) while NPDS male suicide poisoning deaths averaged 9% of male suicide poisoning deaths in WONDER (SD 2%; Range 7%–13%) (table 1). The regression coefficient for the linear relationship between annual deaths recorded in NPDS and WONDER over the study period was 0.18 (p-value<0.001, R^2=0.51).

Most fatal self-poisonings reported in WONDER and NPDS involved drugs. In WONDER, drug-related suicide poisonings averaged 76% of all fatal self-poisoning (SD 4%; Range 67%–82%), and the corresponding values in NPDS were 89% (SD 2%; Range 85%–93%) (figure 1).

DISCUSSION

In this descriptive study, reviewing suicide poisoning mortality data from 2000 to 2020, we compared NPDS near real time data to CDC WONDER final vital statistics data to determine how well national suicide poisoning deaths could be predicted using NPDS data. Our study found that NPDS data, even though more rapidly available, captured a small and variable (8–16%) proportion of suicide poisoning deaths compared with CDC WONDER data. By age and sex, the paediatric age group and
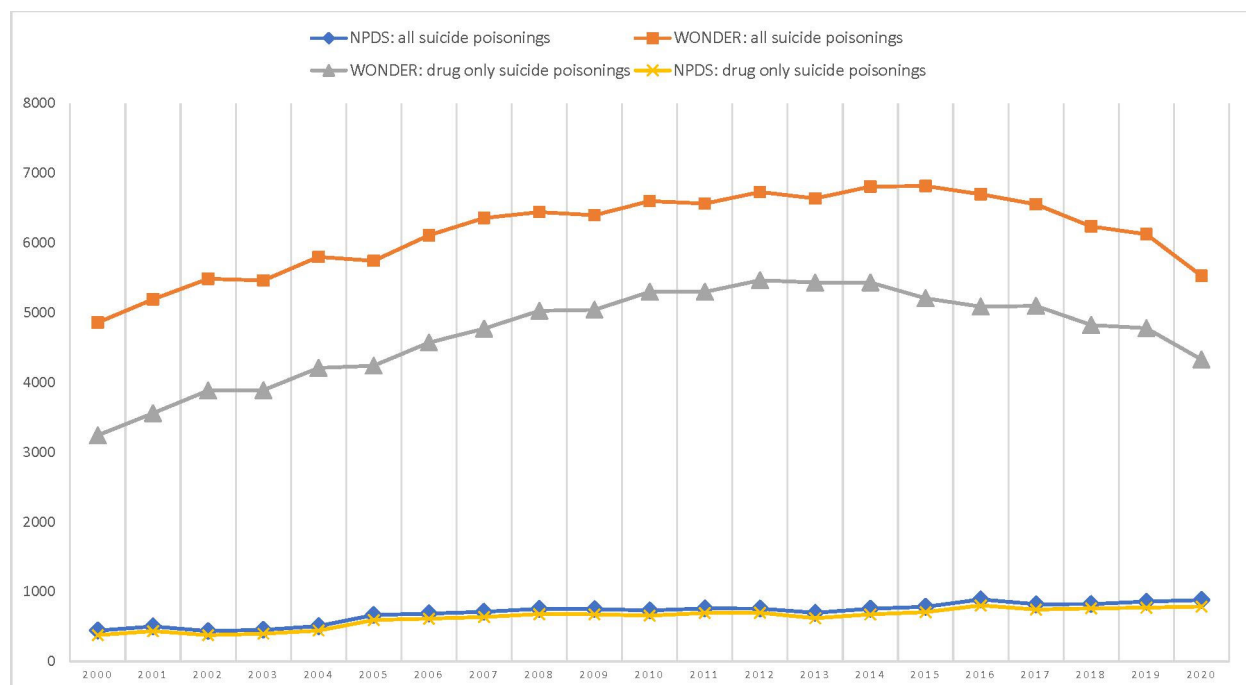

Figure 1 Total and drug-related suicide poisoning deaths in NPDS, WONDER databases from 2000 to 2020.

female sex group had a higher proportion of fatal self-poisoning cases captured in the NPDS dataset, compared with other age groups and male sex group, respectively.

These findings are not unexpected because of the inherent differences between NPDS and CDC WONDER databases. NPDS data is voluntarily reported by the public or health-care professionals primarily for the purpose of clinical patient management. Given this, overdose deaths that occur pre-hospital (ie, patients found dead) are unlikely to be reported to a poison centre because they do not require clinical management. In contrast, CDC WONDER data is final national vital statistics data collected from state registries. Predictably, compared with CDC WONDER, the volume of fatalities recorded in NPDS will inherently be lower.

Some other studies have compared NPDS data with national datasets. Soslow *et al* found a 17% concordance between poison centre records, death certificate, and state medical examiner's office records in Massachusetts, with almost half of all poisoning deaths occurring in hospitals not reported to America's Poison Centres.[10] Hoppe-Roberts *et al* highlighted that deaths reported in Toxic Exposure Surveillance System (TESS); the predecessor of the NPDS, represented 5% of the poisoning deaths reported in NCHS.[11] Mallama *et al* showed that NPDS captured only a small fraction of opioid-involved fatal poisonings when compared with data derived from death certificates.[12] Our results are consistent with the findings from these other studies comparing the NPDS data and national vital statistic data, but with a specific focus on suicide poisonings. As observed in CDC WONDER, most suicide poisoning deaths in the U.S. involved drugs, consistent with previously reported data.[13] Outside the U.S. this is not necessarily the case, however. A recent systematic review of international data on self-poisoning deaths concluded that in Western nations, drugs (including illicit drugs) are most commonly involved, while in Asian countries most fatal self-poisoning involve pesticides.[14]

The strengths of this study include the review of large national databases over a long period of time (21 years). Additionally, we focused on comparing suicide poisoning death data in these databases which hitherto, has not been well reported. A limitation of the study is that the assessment of cause of death in NPDS might not have exactly mirrored that in WONDER, for which the data are derived from final death certificates. In addition, at the time of writing this manuscript, CDC WONDER data were only available to 2020, reflecting the aforementioned lag in the availability of the final cause of death data. Also, we did not conduct any analyses examining the specific types of substances involved in suicide poisoning deaths.

Public health implications

The NPDS data are available close to real time, making it appropriate for surveilling non-fatal suicide poisoning exposures and deaths. The proportion of deaths captured in NPDS however, may not consistently accurately predict national trends in suicide poisoning deaths due to the differences in nature and purpose of both databases.

Disclaimer FDA disclaimer: This article reflects the views of the authors and should not be construed to represent the US Food and Drug Administration's views or policies.America's Poison Centers data disclosure statement: America's Poison Centers® maintains the National Poison Data System® (NPDS), which houses de-identified records of self-reported information from callers to the country's Poison Centers (PCs). NPDS data do not reflect the entire universe of U.S. exposures and incidences related to any substance(s). Exposures do not necessarily represent a poisoning or overdose and America's Poison Centers is not able to completely verify the accuracy of every report. NPDS data do not necessarily reflect the opinions of America's Poison Centers.

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