Preventive Medicine 89 (2016) 317–323

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

# Patterns and trends in accidental poisoning death rates in the US, 1979–2014

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ARTICLE INFO

*Article history:*
Received 30 November 2015
Received in revised form 31 March 2016
Accepted 12 April 2016
Available online 13 April 2016

*Keywords:*
Substance abuse
Mortality
Public health

ABSTRACT

*Objectives.* The purpose of this study was to examine US accidental poisoning death rates by demographic and geographic factors from 1979 to 2014, including High Intensity Drug Trafficking Areas.

*Methods.* Crude and age-adjusted death rates were formed for age group, race, sex, and county for accidental poisonings (ICD 9th revision: E850–E869; ICD 10th revision: X40–X49) from 1979 to 2014 using the Mortality and Population Data System housed at the University of Pittsburgh. Rate ratios were calculated comparing rates from 2014 to 1979, overall, by sex, age group, race, and county. Joinpoint regression detected changes in trends and calculated the average annual percentage change (AAPC) as a summary measure of trend.

*Results.* Drug poisoning mortality rates have risen an average of 6% per year since 1979. Increases are occurring in all ages 15+, and in all race–sex groups. HIDTA counties with the highest mortality rates were in Appalachia and New Mexico. Many of the HIDTA border counties had lower rates of mortality.

*Conclusions.* The drug poisoning mortality epidemic is continuing to grow. While HIDTA resources are appropriately targeted at many areas in the US most affected, rates are also rapidly rising in some non-HIDTA areas.


Poisoning deaths have been increasing in the US since the early 1990s (Warner et al., 2011; Chen et al., 2015). In 2008, poisoning deaths exceeded deaths due to motor vehicle accidents for the first time (Warner et al., 2011) and 89% of these were due to drug poisonings. The majority of poisoning deaths were accidental, or unintentional, from both illicit and prescription drugs. A previous examination of accidental poisoning death rates from 1999 to 2004 found higher rates in males, American Indian/Alaska Natives, 35–44 and 45–54 year olds and in the South and West (Paulozzi and Annest, 2007). However, more recent studies have found that overall death rates are rising for middle-aged non-Hispanic Whites (Case and Deaton, 2015) and for White females ages 15 to 64 (Astone et al., 2015). Astone et al. (2015) attribute some of the rising mortality rates in White females to increases in accidental poisoning deaths, while Case and Deaton identified a combination of increasing poisoning, suicide and cirrhosis death rates for the overall rise in 45–54 year old non-Hispanic White mortality (Case and Deaton, 2015). The increase in accidental poisonings has been generally thought to be due to increases in the number of prescription opioids made available to Whites (Paulozzi and Annest, 2007). A 2008 examination of opioid prescribing patterns found the highest rates in Appalachia and in southern and western states (McDonald et al., 2012), correlating with recent increases in mortality in these areas. In a 2013 study, Rossen et al. (2013) examined 1999–2009 drug poisoning mortality rates by US region and at the county level. They found that in 1999–2000 only 3% of counties had age-adjusted mortality rates (AAMR) greater than 10/100,000; by 2008–2009, 54% of counties exceeded this rate.

The High Intensity Drug Trafficking Areas program was created by Congress in 1988, consisting of 31 areas in the US with high drug trafficking, with coordinated law enforcement resources dedicated to reducing trafficking and production (Appendix). In 2015, the program was funded to begin a "Heroin Response Strategy" specifically aimed at five areas with high rates of heroin trade: Appalachia, New England, Philadelphia–Camden, New York–New Jersey, and Washington–Baltimore. However, to date, accidental drug poisoning mortality rates have not been examined in High Intensity Drug Trafficking Areas.

The purpose of this study was to update and expand upon earlier studies of accidental poisoning deaths by examining rates by sex, race, age, and county from 1979 to 2014 in the US. This study also examined accidental poisoning mortality patterns in High Intensity Drug Trafficking Areas. These analyses will help to inform public health officials and

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http://dx.doi.org/10.1016/j.ypmed.2016.04.007
0091-7435/

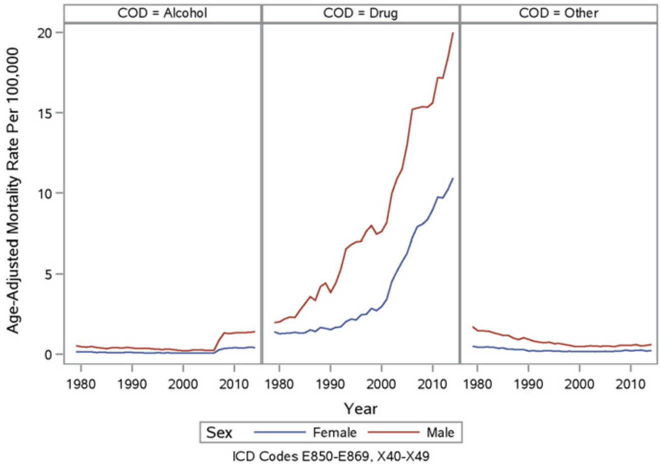


**Fig. 1.** a–c. US age-adjusted accidental poisoning mortality rates per 100,000, 1979–2014, by sex for type of overdose, ages 15+.

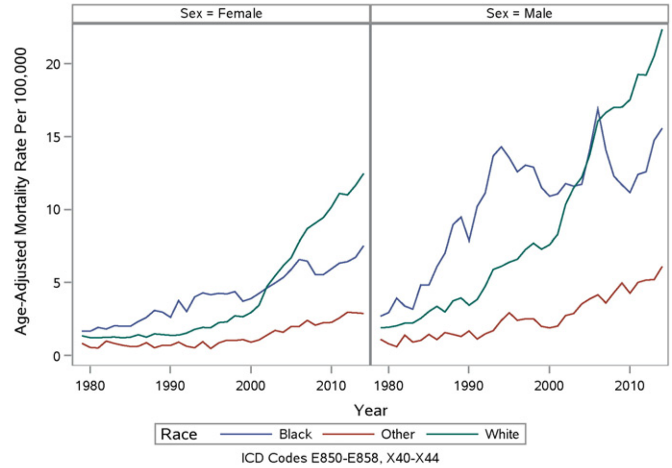


**Fig. 2.** a and b. US age-adjusted accidental drug poisoning mortality rates for males and females by race, ages 15+.

decision makers, law enforcement, and legislators about areas which may be in need of additional resources to combat epidemic levels of accidental drug poisoning mortality.

## 1. Methods

The Mortality and Population Data System (MPDS) (Marsh et al., 2004), a comprehensive repository maintained through the University of Pittsburgh, was used to obtain death counts and corresponding populations by age group (15–24, 25–34, 35–44, 45–54, and 65+), race (White, African American, Other), sex, state, and county from 1979 to 2014. The MPDS contains individual demographic and geographic information plus the underlying cause of death code (using International Classification of Diseases codes) for 120 million+ decedents; we focus here on deaths from accidental poisonings (ICD 9th revision: E850–E869; ICD 10th revision: X40–X49). These codes include accidental poisoning deaths from both prescription drugs, such as prescription opioids, and from illicit drugs, such as heroin. In this analysis we were not able to differentiate type of drug involved in the accidental poisoning. We restricted the analyses to age groups 15+ due to the dearth of drug poisoning deaths in ages younger than 15 (approximately 20–30/year).

We grouped causes of death into type of overdose: drugs (ICD 9th revision: E850–E858; ICD 10th revision: X40–X44); alcohol (ICD 9th revision: E860; ICD 10th revision: X45); and other causes of poisoning (ICD 9th revision: E861–E869; ICD 10th revision: X46–X49). To interpret trends in accidental poisoning mortality across ICD 9th and 10th revisions, the comparability ratio adopted by Baggett and Hwang (Baggett et al., 2013) of 1.195 was applied to 9th revision data. Accidental poisoning codes changed dramatically between the 8th and 9th revision ICD versions, as such these analyses were limited to the time period corresponding to ICD 9th and 10th revision.

The epitab csi command in STATA was used to calculate rate ratios for age-specific rates with corresponding 95% confidence intervals, to compare mortality rates over the 1979 to 2014 time period (StataCorp, 2014). The 2000 standard million weights were applied to calculate age-adjusted mortality rates (AAMR) for ages 15+, based on the previously described age groupings. AAMRs were examined graphically over time by type of overdose, sex, and race.

Standard errors for rates were calculated via methods outlined by the CDC for age-specific rates, age-adjusted rates, and comparability ratio adjusted rates (Centers for Disease Control and Prevention, National Center for Health Statistics, 2000). Standard errors are equal to the rate multiplied by the relative standard error (RSE) of the rate divided by 100, where the relative standard error takes on different forms depending on the type of rate (Centers for Disease Control and Prevention, National Center for Health Statistics, 2000). Confidence intervals for standardized rate ratios (SRRs) were calculated as the ratio of AAMRs raised to the power of (1 plus or minus 1.96 / X), where X is $(SRR_{2014} - SRR_{1979}) / \text{sqrt}(SE(SRR_{2014})^2 + SE(SRR_{1979})^2)$.

Trends in accidental drug poisoning AAMRs overall, by race, and by sex; were analyzed using the Joinpoint regression program (Joinpoint Regression Program, 2015). Age-specific mortality rate trends were

**Table 1**
Numbers, age-adjusted rates per 100,000, standardized rate ratios, and average annual percent change of accidental drug poisoning deaths[a] among persons age 15+ in the US, by selected characteristics.

| | | 1979[c] | | | 2014 | | | SRR | 95% CI | AAPC[b] | 95% CI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Deaths | Rate | 95% CI | Deaths | Rate | 95% CI | | | | |
| Overall | | 2475 | 1.67 | (1.60–1.74) | 38,675 | 15.47 | (15.31–15.63) | 9.26 | (9.01–9.52) | 6.65 | (4.90–8.42) |
| Sex | Male | 1461 | 2.11 | (1.97–2.24) | 24,703 | 19.64 | (19.40–19.89) | 9.31 | (8.98–9.64) | 7.08 | (5.89–8.29) |
| | Female | 1014 | 1.38 | (1.29–1.47) | 13,972 | 10.94 | (10.76–11.13) | 7.93 | (7.58–8.29) | 6.37 | (5.27–7.48) |
| Age | 15–24 | 525 | 1.48 | (1.34–1.62) | 3308 | 7.52 | (7.27–7.78) | 5.08 | (4.67–5.54) | 5.16 | (4.41–5.92) |
| | 25–34 | 805 | 2.67 | (2.46–2.88) | 8854 | 20.35 | (19.92–20.77) | 7.62 | (7.13–8.15) | 6.04 | (4.91–7.19) |
| | 35–44 | 333 | 1.58 | (1.40–1.76) | 8468 | 20.90 | (20.46–21.35) | 13.22 | (11.96–14.62) | 8.00 | (6.66–9.36) |
| | 45–54 | 260 | 1.35 | (1.18–1.53) | 10,052 | 23.13 | (22.68–23.58) | 20.10 | (17.95–22.50) | 8.58 | (6.76–10.43) |
| | 55–64 | 234 | 1.30 | (1.13–1.48) | 6368 | 15.89 | (15.50–16.28) | 12.21 | (10.83–13.77) | 7.52 | (5.96–9.10) |
| | 65+ | 318 | 1.51 | (1.34–1.69) | 1625 | 3.51 | (3.34–3.68) | 2.32 | (2.08–2.60) | 2.41 | (1.92–2.91) |
| Race | Black | 333 | 2.15 | (1.91–2.40) | 3830 | 11.24 | (10.87–11.60) | 5.23 | (4.83–5.66) | 4.92 | (3.34–6.52) |
| | Other | 28 | 0.96 | (0.76–1.66) | 868 | 4.43 | (4.13–4.73) | 4.61 | (3.70–5.76) | 5.36 | (2.57–8.23) |
| | White | 2114 | 1.63 | (1.56–1.70) | 33,977 | 17.47 | (17.28–17.66) | 10.72 | (10.40–11.05) | 7.35 | (6.70–8.00) |

[a] ICD codes E850–E858, X40–X44.
[b] AAPC from Joinpoint regression using age-adjusted mortality rates.
[c] Using comparability ratio of 1.195.