



Full length article

Trends and characteristics of heroin overdoses in Wisconsin, 2003–2012[☆]

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ABSTRACT

Background: Heroin abuse has increased substantially during the past decade in the United States. This study describes trends and demographic shifts of heroin overdoses and heroin-related fatalities in Wisconsin and contrasts these with prescription opioid overdoses.

Methods: This study was cross-sectional using databases of emergency department (ED) visits, hospital admissions, and death certificates in Wisconsin, United States, during 2003–2012. Cases were Wisconsin residents treated for heroin or prescription opioid overdose, and residents who died of heroin-related drug poisoning. Primary measurements were rates over time and by geographic region, and rates and rate ratios for selected demographic characteristics.

Results: During 2003–2012, age-adjusted rates of heroin overdoses treated in EDs increased from 1.0 to 7.9/100,000 persons; hospitalized heroin overdoses increased from 0.7 to 3.5/100,000. Whites accounted for 68% of hospitalized heroin overdoses during 2003–2007 but 80% during 2008–2012. Heroin-related deaths were predominantly among urban residents; however, rural fatalities accounted for zero deaths in 2003 but 31 (17%) deaths in 2012. Among patients aged 18–34 years, those hospitalized with heroin overdose were more often men (73.0% versus 54.9%), uninsured (44.2% versus 29.9%), and urban (84.3% versus 73.2%) than those with prescription opioid overdose. Rates of ED visits for heroin overdose in this age group exceeded rates for prescription opioid overdose in 2012 (26.1/100,000 versus 12.6/100,000 persons, respectively).

Conclusions: An epidemic of heroin abuse is characterized by demographic shifts toward whites and rural residents. Rates of heroin overdose in younger persons now exceed rates of prescription opioid overdose.

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1. Introduction

Heroin is undergoing a resurgence in the United States. According to the National Survey on Drug Use and Health (NSDUH), the number of persons who reported heroin use in the past month increased from 166,000 in 2002 to 335,000 in 2012 (SAMHSA, 2013a). The rate of drug-poisoning deaths involving heroin

increased in tandem from 0.7 to 2.7 per 100,000 persons during 2000–2013 (Hedegaard et al., 2015). Wisconsin appears to be following national trends, as state crime laboratory reports for heroin use increased from 270 cases in 2008 to 647 cases in 2012 (Wisconsin DOJ, 2013). Furthermore, heroin-related admissions at publicly funded substance abuse treatment facilities increased from 983 to 2073 during the same period (SAMHSA, 2013b). This increase in heroin use, both nationally and in Wisconsin, occurs during an epidemic of prescription opioid overdose as reflected in emergency department (ED) visits and mortality (Cai et al., 2010; Centers for Disease Control and Prevention, 2011). National surveys indicate that the majority of recent heroin initiates previously used prescription opioids (Muhuri et al., 2013), which has led public health authorities to question whether causal associations exist between heroin and prescription opioid abuse. Evidence also

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suggests that the demographic composition of heroin users has shifted in the last decade, with increased use among women and persons living outside large urban areas (Cicero et al., 2014).

Despite evidence of increased heroin use and demographic shifts among users, as well as temporal associations with increasing prescription opioid abuse, accurate measurement and characterization of heroin use remain challenging. State-level data, such as crime laboratory reports and treatment admissions, are subject to selection bias and, thus, are not representative of the population of illicit drug users at large, nor do they accurately reflect the magnitude of heroin use. Although surveys can reveal linkages between heroin and prescription opioid use and demonstrate demographic trends, selection and reporting bias might limit generalizability. Population-based longitudinal studies are needed to evaluate these associations among heroin users. Analyses of statewide health care utilization databases and mortality records provide an alternative approach that minimizes such limitations while providing detailed epidemiological data to guide public health strategies.

Using statewide, longitudinal databases of all ED visits, hospital discharges and deaths in Wisconsin, the goal of this study was 3-fold: (1) to estimate burden of heroin use; (2) to identify changing sociodemographic and geographic patterns of heroin overdose cases and heroin-related deaths over time; and (3) to compare age-specific heroin and prescription opioid overdose cases with respect to sociodemographic variables and temporal trends. Findings from this study can be used to design and implement effective public health interventions.

2. Materials and methods

2.1. Sources

Medically attended heroin and prescription opioid overdoses were abstracted from the Wisconsin Division of Public Health's (DPH) ED visit and hospital discharge data sets during 2003–2012. These data sets include all Wisconsin patients treated in Wisconsin hospitals or in neighboring Minnesota hospitals. Data on patients treated at the two Veteran's Administration hospitals in Wisconsin were not available. Only Wisconsin residents were included in the analysis. ED visits include only patients treated and released. Both databases include information about patient demographics, primary and secondary diagnoses, and payer information. Discharge data lack patient unique identifiers and deduplication could not be performed for either ED or hospital encounters. Fatality data during 2003–2012 were abstracted from DPH's vital records and include data about underlying and contributing causes of death, manner of death, and decedent demographics.

2.2. Case definition

Heroin overdoses (HODs) and prescription opioid overdoses (PODs) that resulted in an ED visit or hospitalization were identified by using a modified algorithm from the Safe States Alliance Consensus Recommendations for Poisoning Surveillance (ISW-7, 2012). An HOD case was defined as an ED visit or hospitalization with an *International Classification of Disease, 9th Revision, Clinical Modification* principal diagnosis of heroin overdose (965.01 or E850.0). A POD case was defined as any encounter with a principal diagnosis of intentional or unintentional overdose of an opioid substance other than heroin (965.00, 965.02, 965.09, or E850.1–2). Heroin-related fatalities were defined as any death with an underlying cause of drug poisoning (*International Classification of Disease, 10th Revision* codes X40–44, X60–64, X85, or Y10–Y14), and a contributing cause of death of heroin poisoning (T40.1). POD fatalities had the same underlying cause but a contributing cause in the range T40.2–T40.4.

2.3. Statistical analysis

Overdose rates/100,000 persons by age group, sex, race (black, white, and other), and ethnicity (Hispanic or non-Hispanic) were calculated for the general population by using U.S. Census Bureau annual estimates for 2003–2012 (U.S. Census Bureau, 2012a, 2012b, 2013a, 2013b). Annual age-adjusted rates were computed by using the 2000 U.S. Census Bureau standard population (Day, 1996). Rate ratios for demographic variables were calculated by using the most recent hospital and fatality data (2012) available at the time of this study to demonstrate characteristics of overdose cases. ED demographic variables were not analyzed because of frequently missing race and ethnicity data. Overdose rates were calculated by insurance status by using estimates for the Wisconsin population derived from the 2009–2011 Wisconsin Family Health Survey (Wisconsin OHI, 2013). Rates by marital status and education were calculated by using American Community Survey 1-year estimates (U.S. Census Bureau, 2012c). Consistent with census methodology, rates by marital status and education level were calculated only for persons aged >15 and >25 years, respectively. Overdoses were classified rural or urban on the basis of each patient's zip code of residence, according to the rural-urban commuting area codes version 2.0. As a surrogate for socioeconomic status, each patient's zip code of residence was classified into quartiles by using the percentage of families below the poverty level on the basis of American Community Survey 5-year economic data during 2008–2012 (U.S. Census Bureau, 2012d). Crude rates on the basis of zip code-level and county-level geography were computed with annual zip code tabulation area and county population estimates, respectively, produced by the Wisconsin Demographic Services Center (Wisconsin DOA, 2013). County-level rates were suppressed if based on <5 events. Comparisons of sociodemographic and geographic proportions were performed by using χ^2 analyses. Rate ratios with 95% confidence intervals were computed by using conditional maximum likelihood estimates. Trends in rates were tested by using the Mantel–Haenszel χ^2 test for trend. *P* values <0.05 were considered statistically significant. Temporal demographic changes were examined by comparing 2003–2007, a period of stable overdose and death rates, with 2008–2012, a period of rising rates. The sample was divided into two age groups for comparison based on a sub-analysis demonstrating highest rates of increase in the 18–34 age group. Data abstraction and all analyses were performed by using SAS[®] Enterprise Guide[®] version 5.1 (SAS Institute Inc., Cary, North Carolina), Epi Info[™] version 7.1 (Centers for Disease Control and Prevention, Atlanta, Georgia), and OpenEpi (Open Source Epidemiologic Statistics for Public Health).

3. Results

During 2003–2012, a total of 1540 patients were treated and released from EDs for HOD, and 822 were admitted to the hospital. Age-adjusted HOD rates of ED visits increased 720% from 1.0/100,000 persons in 2003 to 7.9/100,000 in 2012, whereas HOD hospitalization rates increased 390% from 0.7/100,000 persons to 3.5/100,000 (Fig. 1). A total of 692 heroin-related fatalities were identified during 2003–2012, increasing 630% from an age-adjusted rate of 0.5/100,000 persons in 2003 to 3.4/100,000 in 2012.

The geographic distribution of HOD cases expanded during the study period. In 2008, HOD cases were primarily restricted to residents of southern and eastern Wisconsin (Fig. 2). By 2012, HODs cases also were identified among residents of central and northern areas of the state. During 2008, seven of 68 counties with <200,000 residents had ≥ 1 heroin-related fatality; by 2011, 25 of 68 counties had ≥ 1 such fatality.

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