

# Letters

## RESEARCH LETTER

### Risk of Heroin Dependence in Newly Incident Heroin Users

Some 30 to 50 US residents die of heroin overdoses each day.<sup>1</sup> By comparison, an estimated 300 to 520 individuals start heroin use each day.<sup>2</sup> For first-time users, these odds of overdose death might seem remote. For this reason, clinicians and public health practitioners deserve more compelling evidence to share with people who contemplate trying heroin. Seeking reproducible results via 15 US epidemiological samples, we estimate how often newly incident heroin users become dependent on heroin. Estimation focuses on the first 1 to 12 months after first heroin use.

**Methods** | Each year from 2002 to 2016, the National Survey on Drug Use and Health (NSDUH) research staff drew a new US probability sample of noninstitutionalized civilians age 12 years and older. In each year, staff assessed heroin use and dependence using *DSM-IV* criteria via institutional review board-approved protocols for recruitment and standardized computer-assisted self-interviews.

The US Department of Health and Human Services Center for Behavioral Health Statistics and Quality created NSDUH open access analysis files with deidentified data after applying disclosure analyses designed to thwart reidentification of participants. Given the circumstances of open access and no contact with participants, the Michigan State University institutional review board ruled that plans to analyze these data qualified for the federal category “not human subjects research.”

Aggregate files included 837 326 participants, with 1021 identified as new heroin users. All were assessed approximately 1 to 12 months after first use.<sup>3</sup> We estimated year-specific proportions for the chance of becoming dependent on heroin soon after heroin use onset, using StataMP13 (StataCorp) for calculus-derived standard errors and analysis weights. Expecting stable estimates,<sup>4</sup> we used StataMP13 fixed-effects meta-analysis with heterogeneity evaluations. Seeing significant heterogeneity ( $I^2$  statistics with  $P < .05$ ) and possible increasing estimates, we turned to DerSimonian-Laird random-effects estimation. The resulting meta-analysis fixed-effects summary estimates account for unmeasured methodological and/or substantive variation sources across samples year by year, with a set at .10.<sup>4</sup> Additional details were published previously.<sup>5</sup> We specified a contrast of estimates from 2006 to 2010 and from 2011 to 2016 before visual inspection and added estimates from 2002 to 2005 at the request of anonymous reviewers.

**Results** | The number of participants in the data sets ranged from 54 079 to 58 397 per year. Analysis weights made demographic variables balanced with US Census values year by year

(eg, 48% male and 52% female). Participation was secured for more than 70% of designated respondents and more than 80% of sampled dwelling units. The Figure show general reproducibility across 15-year-specific estimates, with a random-effects meta-analysis summary estimate of 30.2% (95% CI, 22.9%-37.5%) becoming heroin dependent within approximately 1 to 12 months after heroin onset. In some recent years, larger point estimates are seen (Spearman  $\rho = 0.52$ ;  $P = .052$ ).

Heroin overdose death rates climbed after 2010.<sup>1</sup> We specified random-effects meta-analysis comparisons of 2 intervals and found that, from 2006 to 2010, risk of dependence was 23.7% (95% CI, 16.8%-30.6%) vs 41.7% (95% CI, 35.3%-48.0%) from 2011 to 2016. We then explored 2002 to 2010 and derived an estimate of 20.1% (95% CI, 15.5%-24.7%). We compared the estimate of 20.3% (95% CI, 14.6%-25.9%) in 2002 to 2009 with 39.9% (95% CI, 31.4%-48.5%) from 2010 to 2016.

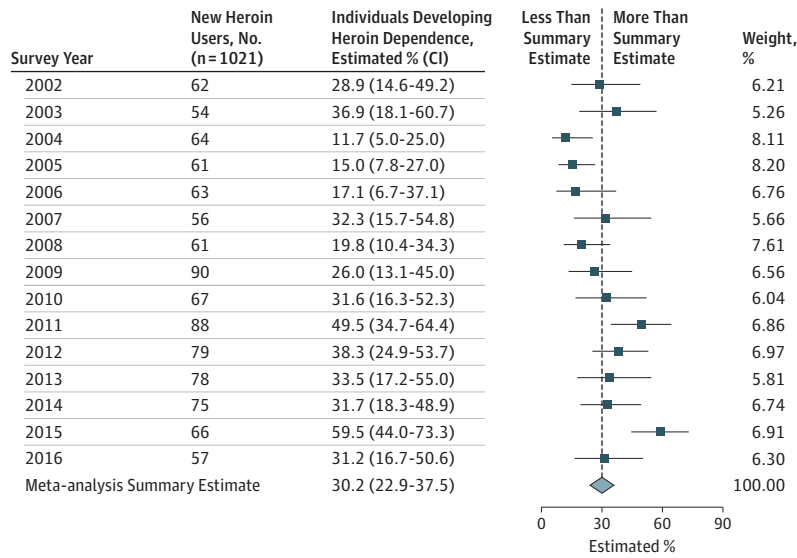
**Discussion** | When observed within approximately 1 to 12 months after heroin onset, an estimated 23% to 38% of new heroin users have become dependent on heroin. Rank-order correlation and post hoc exploratory analyses prompt a hypothesis of recently increased odds of becoming dependent on heroin.

Seeking estimates for comparison, we found 3 published studies on how often heroin dependence was found among people who have used heroin at least once in their lifetime. The National Comorbidity Survey (1990-1992) estimate was 23% dependence rate (with a standard error [SE] of 5%); National Epidemiologic Survey on Alcohol and Related Conditions (2001-2002) estimate (SE) was 28% (4%); and National Epidemiologic Survey on Alcohol and Related Conditions-III (2012-2013) estimate (SE) was 25% (2%).<sup>4,6</sup> These 3 values yield a random-effects meta-analysis summary of 26%, with a 95% CI of 22% to 29%, which clearly overlaps this study's overall finding of 23% to 38% of all participants becoming heroin dependent soon after first heroin use.

**Limitations.** In comparing this article with other surveys, differences in methods deserve consideration (eg, recall errors; cumulative odds of competing heroin dependence-associated risks, such as fatal overdose or incarceration; and left-truncation processes).<sup>5,6</sup> In addition, estimates for 2002 through 2005 are from random-effects meta-analysis models and should be considered as post hoc exploratory data analyses completed after visual inspection of the year-specific estimates. Finally, all conclusions are subject to reevaluation when 2017 to 2018 NSDUH data files are released.

**Conclusions** | Irrespective of whether US heroin users now experience increased odds of becoming heroin-dependent, general principles indicate that primary prevention and early outreach initiatives are needed to control the spread of the nation's current heroin epidemic. We now lack evidence-based inter-

**Figure. Forest Plot of Year-Specific Estimates and Random-Effects Meta-analysis Summary Estimate of Heroin Dependence Within 1 to 12 Months of First Use**



This forest plot shows a preponderance of point estimates to the left of the random-effects meta-analysis summary estimate (vertical dashed line) before 2010 and to the right of the summary estimate after 2010. Outcomes were derived from a Taylor series linearization variance estimation that takes into account the complex multistage sampling plan with application of standard analysis weights. The percentage weight column discloses minor variation of the meta-analysis information weight based on the unweighted number of new heroin users each year, the proportion observed to have developed heroin dependence in 1 to 12 months, and its standard error.

ventions for new heroin users before dependence develops and before medication-assisted treatment is indicated. Neglect of new users might foster incrementally greater challenges and costs in the expansions of heroin dependence treatment service responses to the current public health emergency.

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**Study concept and design:** Anthony, Santiago-Rivera.

**Acquisition, analysis, or interpretation of data:** All authors.

**Drafting of the manuscript:** Santiago-Rivera, Havens, Anthony.

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**Additional Contributions:** These data are from open access public use data files that can be downloaded as Public Use Files from the US Substance Abuse and Mental Health Data Archive web site (<https://pdas.samhsa.gov/#/>). The authors agree to provide Stata do-files to create the study variables by request to the senior author (Dr Anthony).

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